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Volume Sensor Development Test Series 5 — Multi-Compartment System

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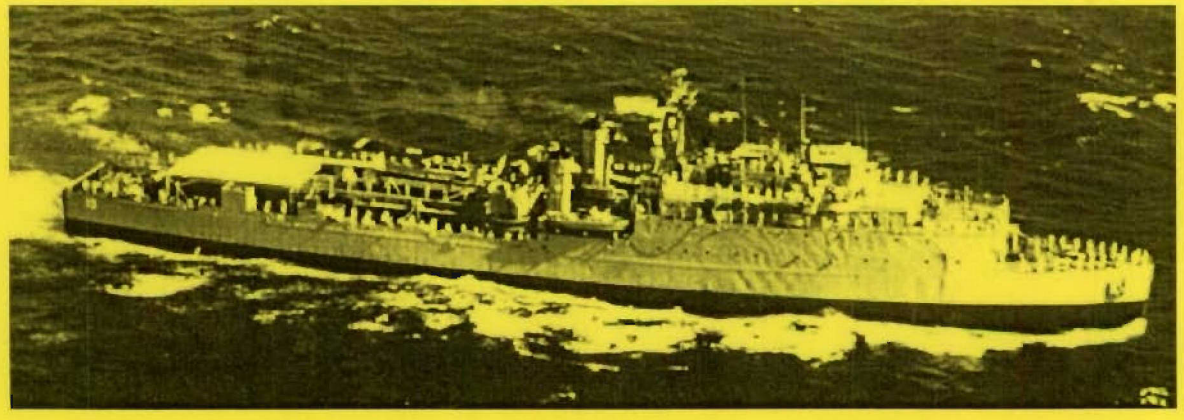

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14. ABSTRACT

The Volume Sensor Prototype (VSP) system has been designed to detect, flame, smoldering fires, water releases (e.g., pipe ruptures), gas leaks, and hot objects and to discriminate nuisance sources, such as hot work. The tests presented in this report were conducted on the ex-USS *Shadwell* from July 25 to August 5, 2005, to evaluate the VSP systems operating in six test compartments. The VSP performance was compared to the performance of state-of-the-art spot-type smoke detection systems. The VSP systems demonstrated the ability to function in multiple compartments, specifically discriminating between multiple types of events in multiple compartments. The VSP systems demonstrated the ability to discriminate between source types by detecting flaming and smoldering fire sources, water releases, and gas releases while rejecting nuisance sources. The VSP systems generally performed better than Video Image Detectors and spot-type smoke detection systems relative to range of detection capabilities, ability to detect fires, ability to reject nuisance sources, and speed of response.

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Damage Control	Sensors	Acoustic Signatures	Long Wavelength Video Detection	Volume Sensor Prototype
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CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AC	alternating current
ACST	acoustic
ACH	air changes per hour
ADC	Advanced Damage Countermeasures
AFSS	Autonomic Fire Suppression System
AGS	Advanced Gun System
AHWS	Advanced Hybrid Watermist System
API	Application Programming Interface
AMD	Advanced Micro Devices
AVI	audio video interleave
CCD	charge coupled device
CCTV	closed circuit television
COTS	commercial-off-the-shelf
CnC	command and control
CVN	carrier vehicle, nuclear
DC	damage control
DCC	Damage Control Central
DCN	distributed control network
DFAM	data fusion algorithm module
DD(X)	21st century destroyer. The Navy's future multi-mission surface combattant.
DoD	Department of Defense
DNA	Did Not Alarm
DVR	digital video recorder
EDM	engineering development model
EST	Edwards Systems Technology
F	Fire
FM	fusion machine
FOV	field-of-view
FY	fiscal year
G	Gas Release
GUI	graphical user interface
HCI	human-computer interaction
HLSM	high-level software module
HSI	human-system interface
IR	Infrared
LPES	Limited Protection Exhaust System
LWVD	long wavelength video detection
NIR	near-infrared
NRL	Naval Research Laboratory
ODM	optical density meter
OH	overhead
OPS	Operations Office
PC	personal computer
PVLS	Peripheral Vertical Launch System
QAWTD	quick acting water tight door
S	Smoke
SBVS	spectral based volume sensor
SCBA	self contained breathing apparatus

SFA	smoke and fire alert
SS	Sensor Suite
SSMC	Secondary Ship Mission Center
SU	Suppression
TBD	to be determined
TC	thermocouple
TCP/IP	Transmission Control Protocol/Internet Protocol
TSCE-I	Total Ship Computing Environment Infrastructure
UDP	user datagram protocol
VID	video image detection
VS	volume sensor
VSCS	Volume Sensor Communications Specifications
VSP	Volume Sensor Prototype
W	Water
WTD	water tight door

EXECUTIVE SUMMARY

Improved Damage Control (DC) capabilities are being developed and demonstrated in the Advanced Damage Countermeasures (ADC) program. An important element of the ADC Program is the development of a Volume Sensor (VS) system that can assess damage conditions within a space without relying on point detection or spot-type fire detectors. The VS program seeks to advance new commercial Video Image Detection (VID) technologies via the integration of near infrared (IR) cameras, wavelength-resolved, single-element sensors, and microphones. Alarm algorithms were developed that fuse the data produced by the VS components, for improved situational awareness and damage control assessment onboard Navy ships. The Volume Sensor Prototype (VSP) system has been designed to detect, flame, smoldering fires, water releases (e.g., pipe ruptures), gas leaks, and hot objects and to discriminate nuisance sources, such as hot work.

Two volume sensor prototype (VSP) systems were successfully evaluated in previous dedicated tests in single spaces on the ex-USS Shadwell. Based on this work, the VSP systems were expanded to operate in multiple compartments while being exposed to multiple sources simultaneously. The tests presented in this report were conducted on the ex-USS *Shadwell* from July 25 to August 5, 2005 to evaluate the expanded VSP systems operating in six test compartments. The test spaces allowed for a performance assessment of the VSP systems in varying light levels and unique space configurations.

This work expanded the database of test scenarios and compartment conditions from which continuing prototype development and revisions can be based. The performance of the VSPs were compared to the performance of state-of-the-art spot-type smoke detection systems. Based on the analysis of this test series, the following conclusions are presented:

- The VSP systems demonstrated the ability to function in multiple compartments, specifically discriminating between multiple types of events in multiple compartments.
- The VSP systems demonstrated the ability to discriminate between source types by detecting flaming and smoldering fire sources, water releases, and gas releases while rejecting nuisance sources.
- The VSP systems generally performed better than VID and spot-type smoke detection systems relative to range of detection capabilities, ability to detect fires, ability to reject nuisance sources, and speed of response.
- The ability of the AFSS control system to interface with the VSP was successfully demonstrated.
- The viability of the Volume Sensor approach in a node-room architecture was also successfully demonstrated.

VOLUME SENSOR DEVELOPMENT TEST SERIES 5 – MULTI-COMPARTMENT SYSTEM

1.0 INTRODUCTION

The Advanced Damage Countermeasures (ADC) program is developing and demonstrating improved damage control (DC) capabilities. An important element of the ADC Program is the development of a Volume Sensor (VS) system that can assess damage conditions within a space without relying on point detection or spot-type fire detectors. The first phase of this program (FY01) consisted of a literature and industry review of current and emerging technologies [1]. Based on the FY01 work, several technologies were identified as having potential for meeting the objectives of the VS development effort. Work preformed during FY02 provided a basis for moving forward with the use of Video Image Detection (VID) for shipboard applications [2]. The test results indicated that the VID systems using smoke alarm algorithms could provide equivalent or superior detection compared to spot-type smoke detectors for most of the conditions evaluated.

One task of the FY03 work was to evaluate video-based fire detection systems onboard the ex-USS *Shadwell*, the Naval Research Laboratory full-scale fire research facility in Mobile, Alabama [3]. These systems were evaluated in two test series conducted 7-18 April and April 21-25, 2003, in which the detection systems were exposed to various fire and nuisance sources. The first test series was Test Series 2 of the carrier vehicle, nuclear (CVN) 21 Fire Threat to Ordnance program conducted April 7-18, 2003 [4]. During the tests, the video image fire detection systems were evaluated in an environment designed to represent magazine storage and was exposed to two fire scenarios: adjacent space fires and in-space wood crib fires [5]. Due to the limited fire scenarios that were conducted during the Magazine Test Series 2, a separate test series was conducted specifically for the VS program to provide a broader range of fire and nuisance source exposures. This additional test series (Test Series VS1) was conducted on the ex-USS *Shadwell* on April 21-25, 2003 [6]. Analysis of the data from these shipboard tests indicated potential issues with VID performance relative to camera settings.

In the VS2 Test Series [7], conducted in a laboratory mockup of ship spaces between August 2003 and January 2004, the performance of the video image fire detection systems were evaluated under varying light conditions and camera settings. Spectral and acoustic sensors were utilized to measure potential event signatures that could be integrated with the VID technology to expand the capabilities and to compensate for deficiencies with the current video image fire detection systems. This test series expanded on the previous FY03 Test Series VS1.

Over the first three quarters of FY04, a multi-component prototype volume sensor system was made via the integration of near infrared (NIR) cameras, spectral sensors, microphones and the commercial VID systems, along with the development of alarm algorithms that fuse the data from the multiple sensor inputs. The fusion of data and execution of the alarm algorithms was accomplished with a personal computer (PC)-based Fusion Machine (FM). One task of the FY04 work was to evaluate the multi-component prototype system onboard the ex-USS *Shadwell* in two test series conducted July 6-16 (VS3) and October 18-29, 2004 (VS4) [8,9].

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During the two test series the detection systems were exposed to various fires, nuisance, and pipe rupture sources. The response of the prototype volume sensor system that consisted of suites of co-located sensors and fusion algorithms was evaluated during the two test series. In the first prototype evaluation test series (VS3), the execution of the Volume Sensor Prototype (VSP) system was very successful. However, the performance for both of the commercial VID systems was unexpectedly poor compared to the VS2 test series performance [7]. The ability of both VID systems to correctly identify and detect fire sources was in the 90 percentile during VS2 and dropped to as low as 32% during VS3. Various issues were identified as potential causes for the marked difference in performance. After analysis of the issues, corrective actions were taken and implemented in test series VS4 [10]. The overall performance of the VS system in VS4 was excellent, correctly classifying 100% of fire sources, 94% of the pipe ruptures, and on average approximately 75% of the nuisance sources [9].

Testing of the VSP thus far had been limited to single compartment configurations in order to develop, refine, and demonstrate the capabilities of the VS components and FM algorithms. This test series (VS5) evaluated the VSP in multiple compartments with multiple sources. The VSP sensor suites were located in five ship compartments and subjected to various sources, some occurring simultaneously. The scenarios tested the capability of the system to detect fire sources and ruptures while concurrently rejecting nuisance sources. The VSP system was also successfully integrated with the DD(X) Autonomic Fire Suppression System (AFSS) control system [11].

2.0 OBJECTIVES

One objective of this test series was to experimentally evaluate the ability of the VSP system to operate in multiple compartments while detecting multiple casualties and simultaneously ignoring nuisance sources. A second objective of this test series was to evaluate the performance of the refined alarm algorithms. The testing of the VSP system assisted in establishing the performance sensitivity and limitations of the revised suite of sensors to various fire and nuisance sources, pipe ruptures, gas leaks, and environmental conditions that may occur onboard ship. The performance of the VSP system and the fusion algorithms were compared to the response of multiple state-of-the-art smoke detection technologies. The successful integration of the DD(X) AFSS control system with the VSP system was also evaluated.

Specific objectives included:

- Demonstrating the ability of the VSP system to function in multiple compartments, specifically discriminating between events of multiple categories in multiple compartments;
- Demonstrating the ability of the VSP system to discriminate between source types by detecting fire sources, gas leaks, and water flow ruptures while rejecting nuisance sources;
- Evaluating the fire detection capabilities of the VSP system relative to conventional detection methods, such as state-of-the-art, commercial-off-the-shelf (COTS) spot-type smoke detectors;

- Evaluating the progress made by advances in the VSP system components and the FM algorithms; and
- Demonstrating the ability of the AFSS control system to interface with the VSP.

3.0 APPROACH

The objectives were achieved by conducting full-scale experiments in several compartments located aboard the ex-USS *Shadwell* in Mobile, AL [3]. The VSP sensor suites (SS) and various smoke detection technologies were installed within the test compartments onboard the ship. The detectors were exposed to a broad range of relatively small fires, adjacent space fires, various nuisance sources, gas leaks, and pipe ruptures that challenged the detection systems. Testing included single and multiple source scenarios. The test data were analyzed to establish the VSP detection system percent correct classification by source type and the times to alarm.

4.0 EXPERIMENTAL TEST SETUP

The tests were conducted in the 2nd and 3rd deck magazines, the electronics space within the 3rd deck magazine, the 2nd deck starboard passageway, the operations office just starboard of the 2nd deck magazine, and in the Peripheral Vertical Launch System (PVLS) on the ex-USS *Shadwell*. Figure 1 shows the layout of the spaces in the vicinity of the 3rd deck magazine and Fig. 2 shows the layout of the spaces on the 2nd deck. Figure 3 shows the PVLS located on decks 3, 4, and 5 aft of frame 29 on the starboard side of the *Shadwell*. Table 1 contains the overall dimensions of the compartments and the passageway included in this test series. VSP sensor suites and instrumentation such as thermocouples (TCs), optical density meters (ODMs), and COTS spot-type smoke detectors were added to the six spaces. The instrumentation monitored the environment and the spot-type detectors provided alarm times that were compared to the VSP alarm times. A majority of the VSP component subsystem computers were located on the mess deck in the bakery while the acoustic sub-systems, COTS smoke detector panel, and data acquisition passed through the port side 3rd deck node room outboard of the 3rd deck magazine and the 2nd deck node room on the starboard side just forward of frame 22. The Fusion Machines (FMs) were located in the control room while the AFSS control system was located on the mess deck in Damage Control Central (DCC). A summary of the test setup is provided in the following sections.

4.1 Test Spaces

The six test spaces, 3rd deck magazine for the DD(X) Advanced Gun System (AGS magazine), electronics space, 2nd deck magazine, operations office, 2nd deck passageway, and the PVLS magazine are described in detail in the following sections. Each space is unique in its size, shape, and content, with varying aspect ratios, configurations, and obstructions.

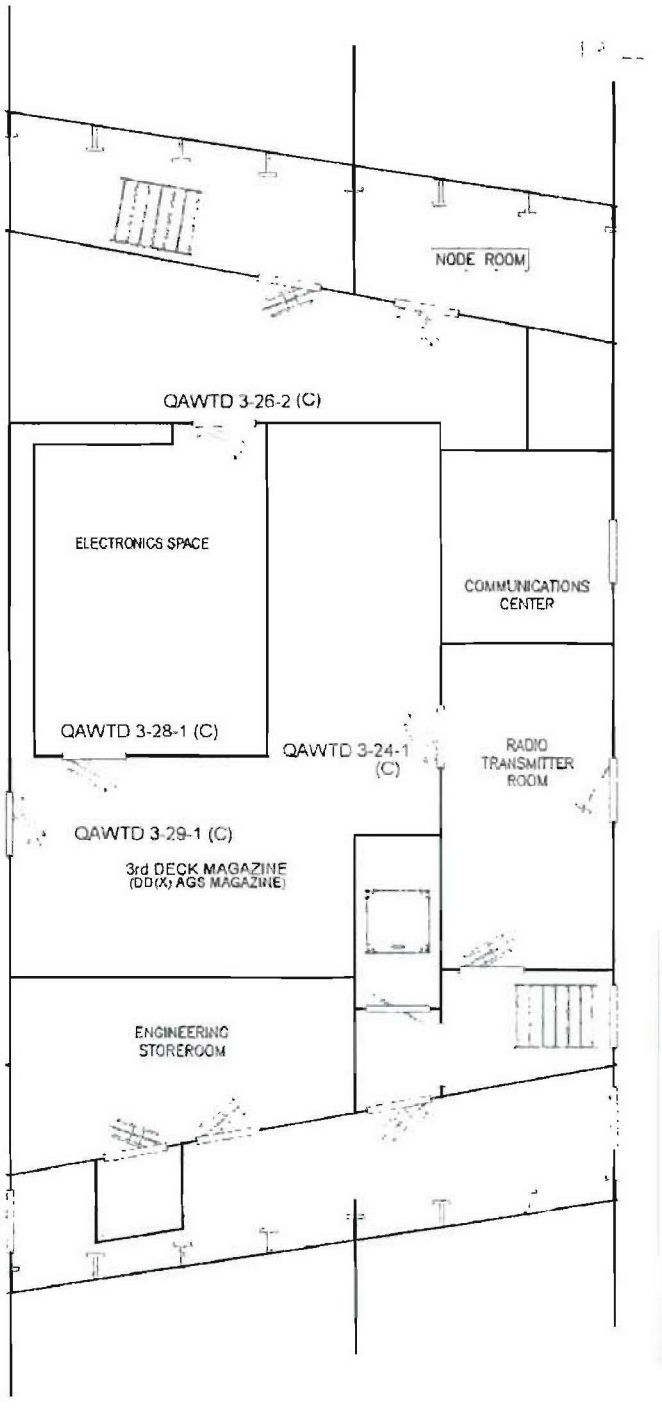

Fig. 1 — Layout of the spaces in the vicinity of the 3rd deck magazine

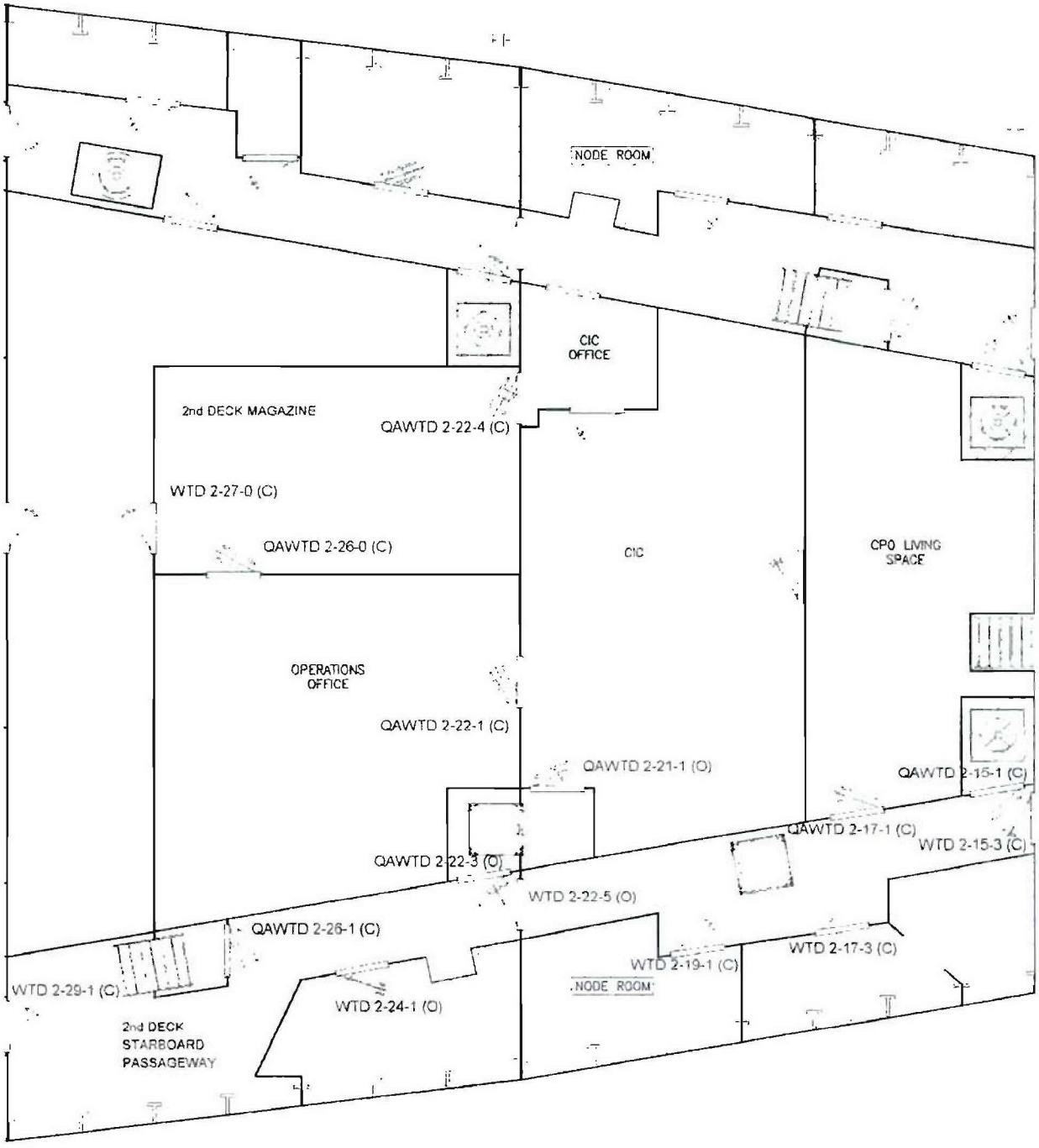

Fig. 2 — Layout of the spaces on the 2nd deck

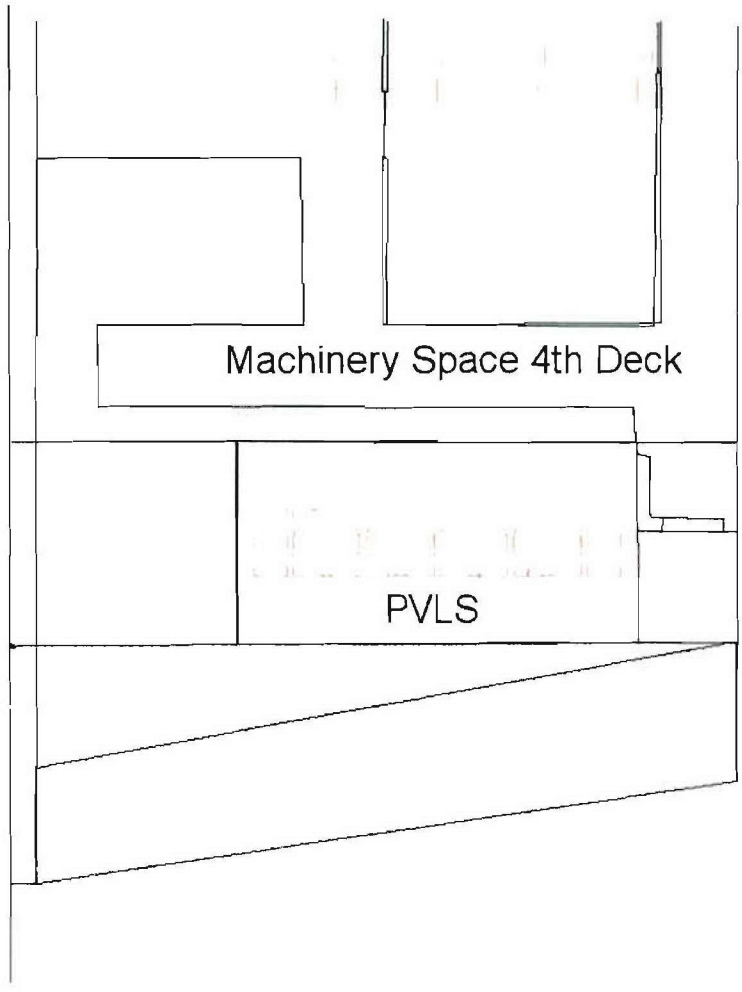

Fig. 3 — Layout of the PVLS 4th deck

Table 1 — Nominal Dimensions of the Spaces Used in this Test Series

Compartment	Length (m(ft))	Width (m(ft))	Height (m(ft))	Area (m^2(ft^2))	Volume (m^3(ft^3))
3rd deck magazine*	6.1 (20.0)	8.1 (26.5)	3.0 (10.0)	31.3 (338.0)	99 (3,572)
Electronics space	4.9 (16.0)	3.7 (12.0)	2.7 (9.0)	18.1 (192.0)	49 (1,728)
2nd deck magazine	6.1 (20.0)	3.6 (11.8)	3.0 (10.0)	22.0 (236.0)	64 (2,301)
Operations office	6.1 (20.0)	5.4 (17.9)	3.0 (10.0)	33.0 (358.0)	96 (3,490)
2nd deck stbd passageway	16.8 (55.5)	1.1 (3.7)	3.0 (10.0)	18.5 (205.4)	55 (2,053)
PVLS	8.4 (28.0)	3.0 (10.0)	9.1 (30.0)	25.0 (280.0)	229 (8,400)

* The 3rd deck magazine, due to the electronics space, has an irregular shape with a varying compartment height. The length and width are overall dimensions, but the area and volume account for the space occupied by the electronic space.

4.1.1 3rd Deck Magazine

A mock magazine on the 3rd deck of the ex-USS *Shadwell* was used as a test space. The 3rd deck magazine has been used for previous detection technology tests [6,8,9]. This test space designation, an attribute from previous test series is not relevant in these studies but is used for its familiarity with test personnel and ship's force. The 3rd deck magazine had an irregular shape due to an electronics space built within the magazine, a box in a box arrangement. The space also contains a 1.1 m x 2.2 m x 2.59 m high (3.7 ft x 7.3 ft x 8.5 ft) vestibule located in the forward, starboard corner of the space and a large Limited Protection Exhaust System (LPES) ventilation shaft that runs vertically through the test compartment. The LPES measures 1.72 m (5 ft 8 in.) in diameter and is located 0.86 m (2 ft 10 in.) from the starboard bulkhead and 1.25 m (4 ft 5 in.) from the aft bulkhead. The electronics space creates gaps in between the aft and port bulkheads of the two compartments and a crawl space over the electronics space that was approximately 0.3 m (1.0 ft) high.

During the previous two VS test series onboard the ex-USS *Shadwell*, VS3 and VS4, the overhead of the magazine space contained 30.5 cm (12.0 in.) transverse beams 1.2 m (4 ft) on center. Since these tests the port side overhead was altered to more closely reflect the anticipated design in the upper level of the DD(X) AGS magazine during the DD(X) AGS magazine AFSS Test Series [12]. The transverse beams on Frames 26 and 28 were increased to 35.6 cm (14.0 in.) in depth, and the other transverse stiffeners were reduced to 15.2 cm (6.0 in.) in depth. Longitudinal beams were added at 0.6 m (2.0 ft) intervals on the port side of the centerline beam. The beams were 17.8 cm (7.0 in.) deep.

An overhead grid system was installed in the magazine space to replicate an actual shipboard magazine [4]. The grid was approximately 2.4 m (8 ft) off the deck. The nominal spacing of the overhead grid was approximately 1.2 m x 1.2 m (4.0 ft x 4.0 ft). Further details of the overhead grid system can be found in the CVN 21 Fire Threat to Ordnance Test Plan [4]. Portions of the grid have been removed in preceding test programs.

In addition to the overhead beams, light fixtures, and a partial overhead grid in the 3rd deck magazine, obstructions in the form of mock AGS pallets were located within the compartment. The mock pallets were approximately 2.4 m (8.0 ft) in height, 1.22 m (4.0 ft) wide, and varied from 0.61 to 1.22 m (2 ft to 4 ft) in length. Figure 4 shows the layout of the mock AGS pallets within the 3rd deck magazine.

4.1.2 Electronics Space

The electronics space within the 3rd deck magazine was used as a test compartment. Figure 5 contains a 3-dimentional graphic of the space. The overall dimensions of this space were 4.9 m (16.0 ft) aft to fwd, 3.7 m (12.0 ft) starboard to port, with a height of 2.7 m (9.0 ft). The electronics space contained the frame work for a raised floor that was approximately 0.33 m (13 in.) high. Light fixtures were installed in the overhead.

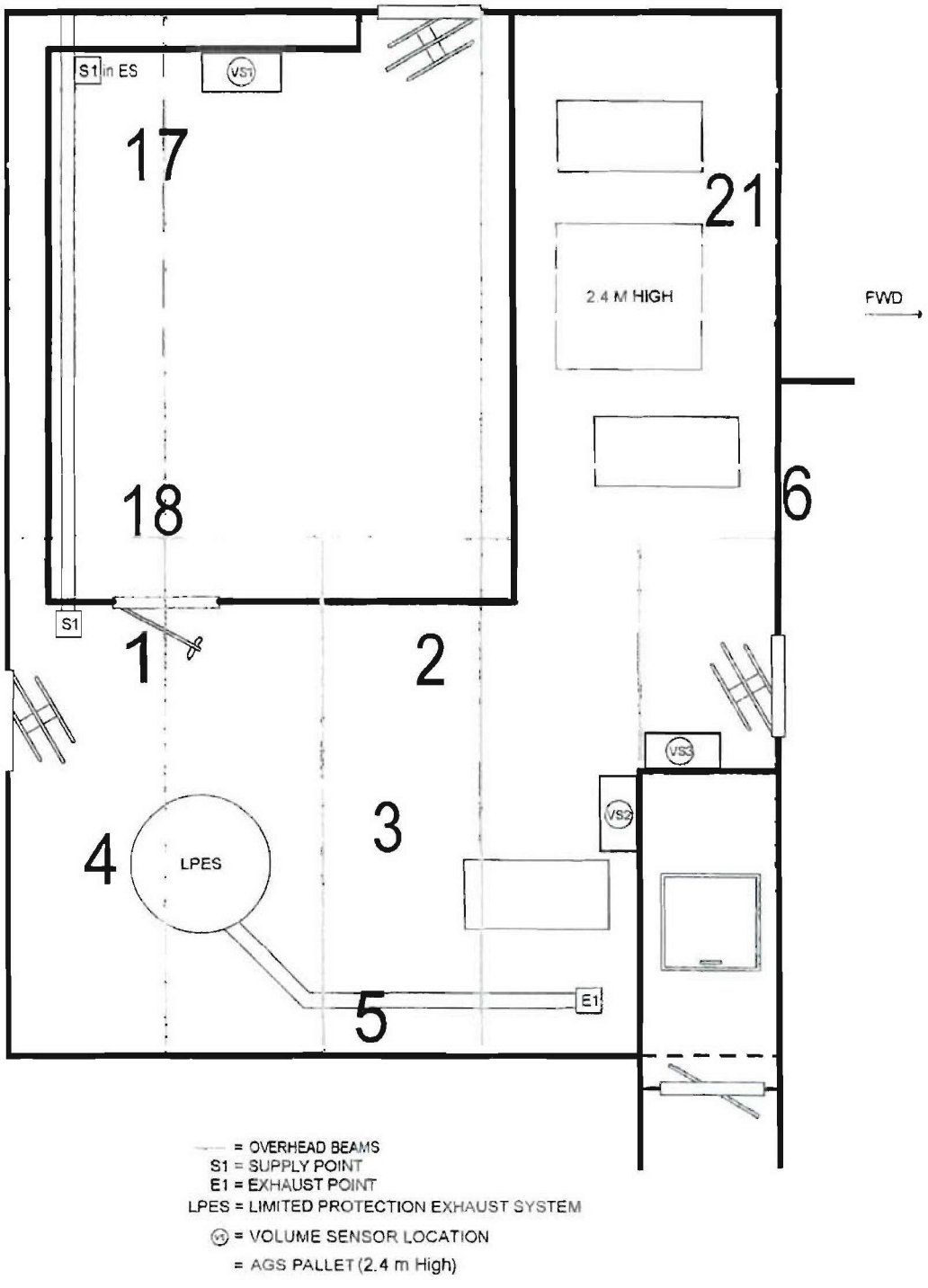

Fig. 4 — Layout of deck obstructions, VS suite and source locations within 3rd deck magazine

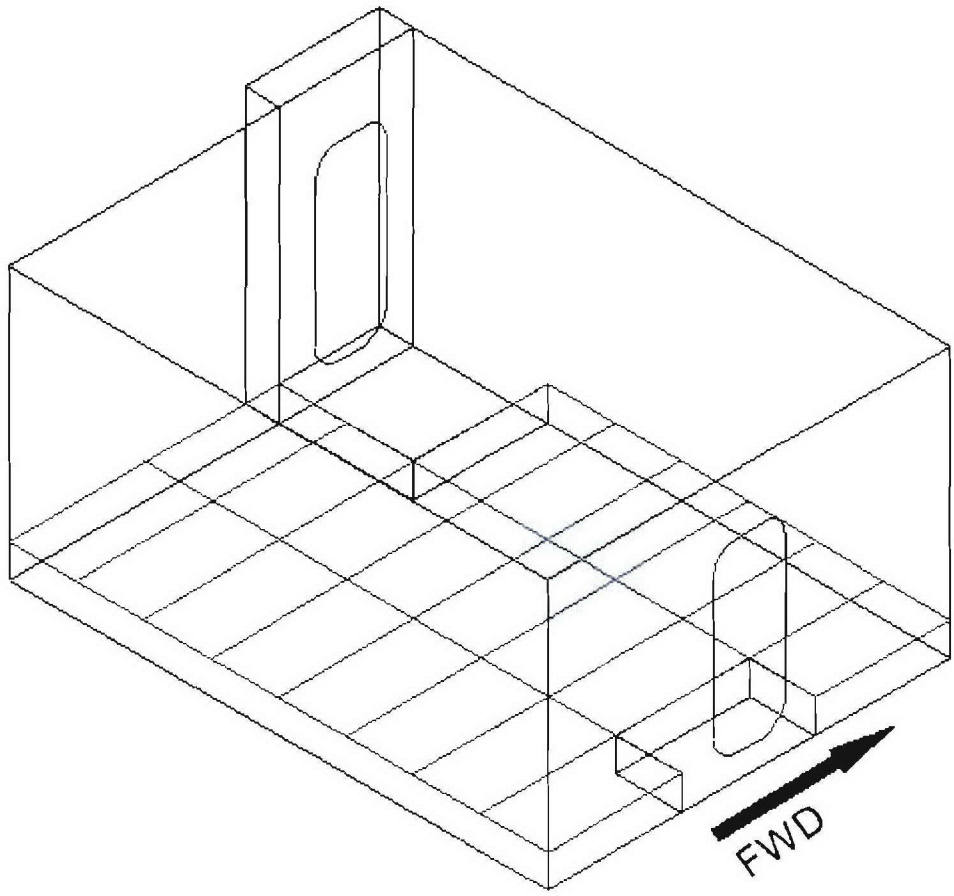

Fig. 5 — 3 dimensional figure of the electronics space

4.1.3 2nd Deck Magazine

The mock magazine on the 2nd deck of the ex-USS *Shadwell* was used as a test space. The overall dimensions of this space were 6.1 m (20.0 ft) forward to aft, 3.6 m (11.8 ft) port to starboard, and 3.0 m (10.0 ft) high. The 2nd deck magazine has been used previously during the CVN 21 Fire Threat to Ordnance Tests Series [4] and the Volume Sensor Test Series VS1 [6]. Similar to the 3rd deck magazine, the 2nd deck magazine contained overhead beams and a grid as well as light fixtures that obstructed the view to the overhead of the compartment.

In addition to the light fixtures, overhead (OH) beams, and the OH grid, cabinets were placed on the deck within the compartment. The cabinets varied in height and were dispersed throughout the compartment. Figure 6 shows the layout of the cabinets within the 2nd deck magazine, the layout is similar to the layout used in CVN 21 Fire Threat to Ordnance [4].

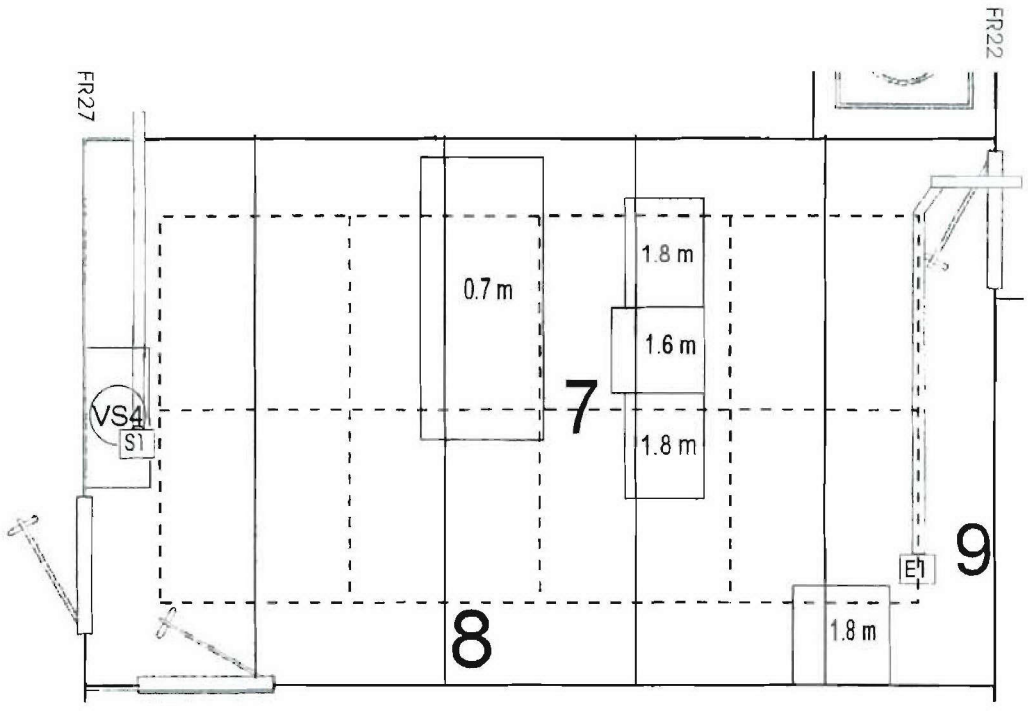

Fig. 6 — Layout of deck obstructions, VS suite and source locations within 2nd deck magazine

4.1.4 Operations Office (Ops)

The operations office on the 2nd deck of the ex-USS S*hadwell* was used as a test space. The overall dimensions of this space were 6.1 m (20.0 ft) forward to aft, 5.4 m (17.9 ft) port to starboard, and a height of 3.0 m (10.0 ft). There was a vestibule located in the forward, starboard corner of the space that measured 1.2 m x 1.6 m x 3.0 m high (4.0 ft x 5.2 ft x 10.0 ft) that was not part of the test space. As shown in Figs. 7 and 8, a large ventilation duct (0.46 m by 0.46 m (1ft 6 in. by 1 ft 6 in.)) ran horizontally through the compartment at a height of approximately 1.8 m (6 ft) above the deck. Beams in the compartment ran port to starboard.

Obstructions, in the form of cabinets, were placed in the operations office. The cabinets varied in height and were dispersed throughout the compartment. Figure 7 shows the ventilation duct, source locations, and the layout of the cabinets within the 2nd deck operations office (VS5_001 – VS5_034). Figure 8 shows the ventilation duct, source locations, and the layout of the cabinets adjusted to accommodate source location 22 within the 2nd deck operations office (tests VS5_035 – VS5_039).

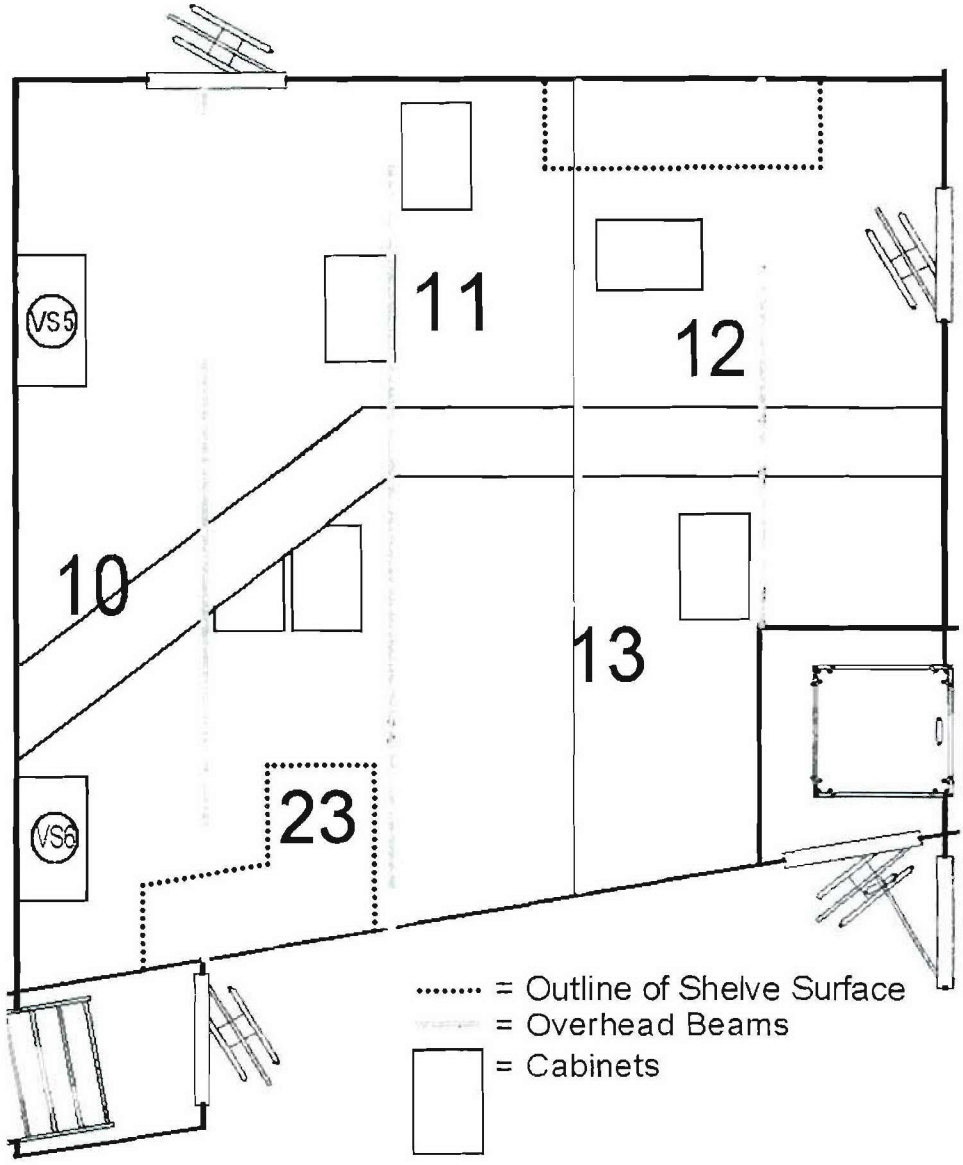

Fig. 7 — Layout of deck obstructions, VS suite and source locations within 2nd deck operations office for tests #1 - #34

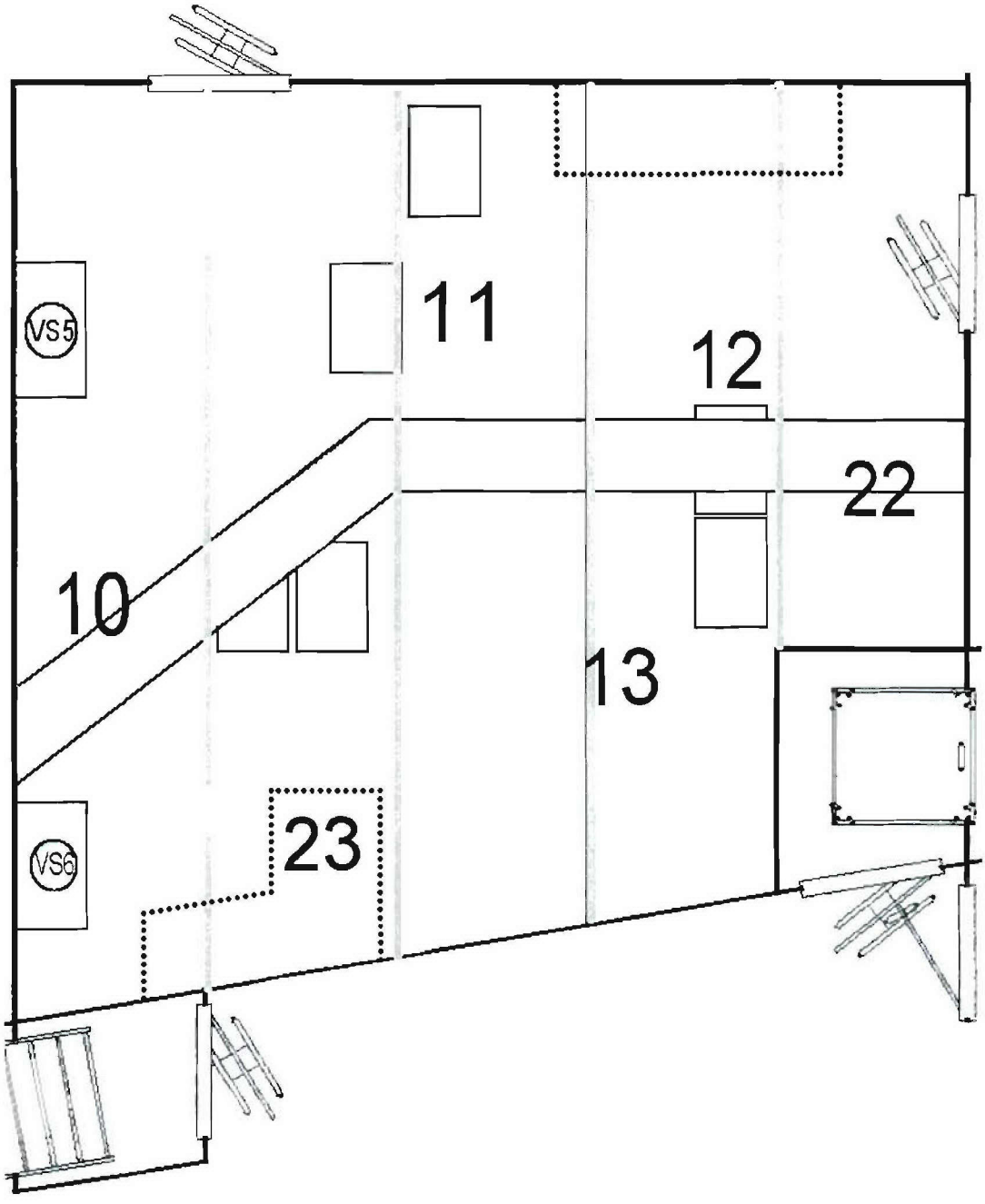

Fig. 8 — Layout of deck obstructions, VS suite and source locations within 2nd deck operations office with source location 22 and deck obstructions altered for tests #35 - #39

4.1.5 2nd Deck Starboard Passageway

The starboard passageway on the 2nd deck of the ex-USS *Shadwell* was used as a test space. The overall dimensions of this space were 16.8 m (55.5 ft) forward to aft, 1.1 m (3.7 ft) port to starboard, and a height of 3.0 m (10.0 ft). A door separated the aft and fwd section of the passageway. The door was left open during testing to elongate the passage way and evaluate the effectiveness of the volume sensor system viewing through the opening. Figure 9 shows the starboard passageway in relation to the operations office.

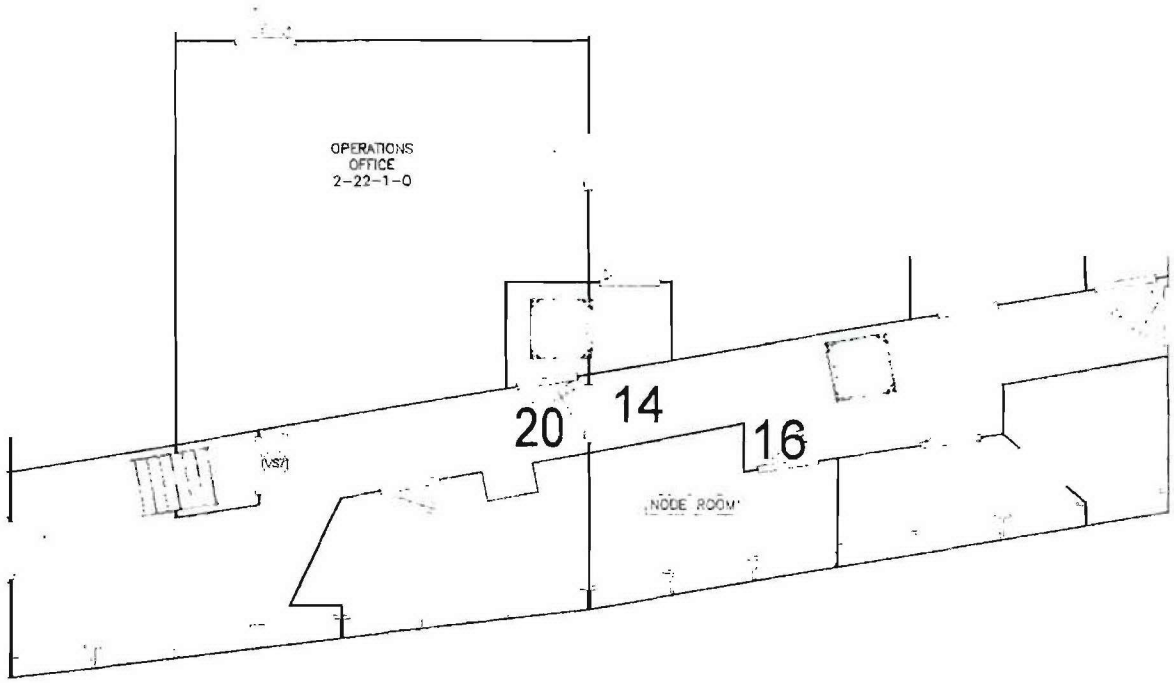

Fig. 9 — Layout of the 2nd deck starboard passageway, including VS suite and source locations

4.1.6 Peripheral Vertical Launch System (PVLS)

As shown in Fig. 3, the PVLS space was located on the starboard side between Frames 29 and 36, and extended vertically from the 5th deck to the 3rd deck. Figure 10 shows a schematic of the PVLS structure within the space. The approximate dimensions of the space were 8.4 m (28 ft) long, 3.0 m (10 ft) wide and approximately 9.1 m (30 ft) high.

The full-scale PVLS mockup was constructed using two real canisters and two mock canisters constructed from metal ductwork. Tubular frame and metal ductwork to simulate the canister support structure and canister exhaust plenums were also included. The PVLS mock up canisters and grating between each of three levels comprised the obstructions. Figure 10 shows the PVLS with a VSP sensor suite located at the top of the space viewing downward through the semi-obstructed grating.

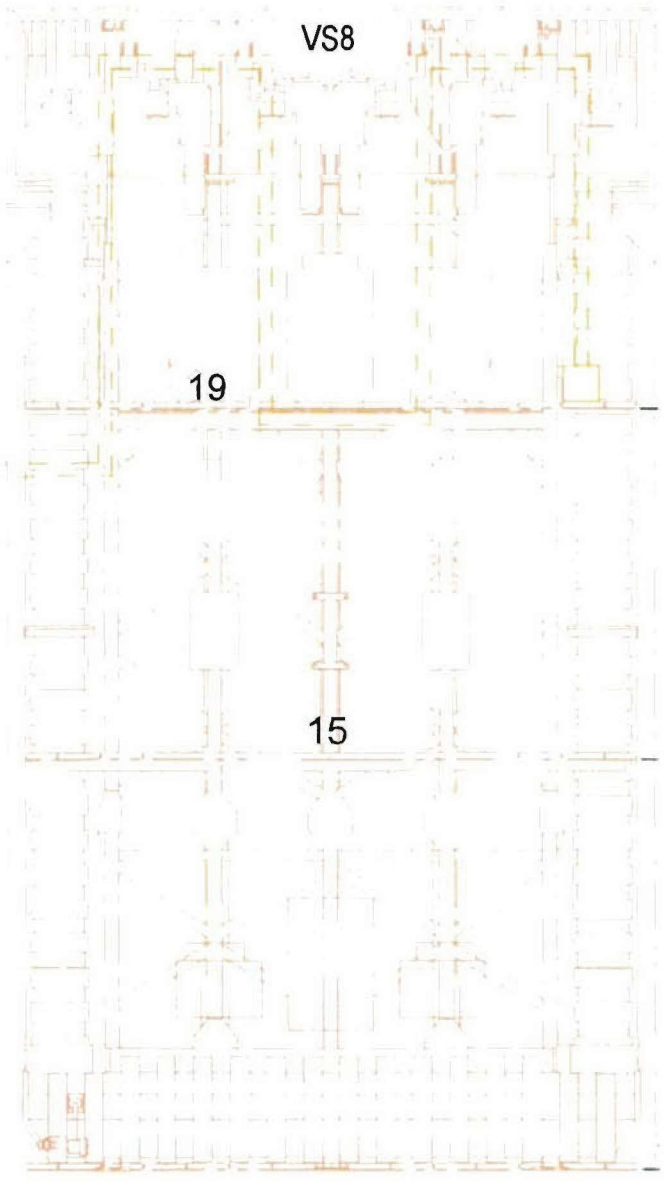

Fig. 10 — Profile view of PVLS with VS sensor suite and source locations

4.2 Lighting

Lighting was installed in the test compartments to provide typical illumination for various spaces onboard naval ships. The lighting was in the form of standard 0.61 m (2 ft) florescent light fixtures, each containing two 20 W bulbs. The lighting systems were installed in general accordance to Department of Defense (DoD)-HDBK-289 [13]. The lighting was suspended approximately 0.3 m (12 in.) below the overhead of the 3rd deck magazine, electronics space, 2nd deck magazine, operations office, and Starboard passageway. Light fixtures in the PVLS were mounted to the inboard bulkhead approximately 0.9 m (3 ft) above the grating on each level.

A photometric survey was conducted in each compartment to document the uniformity and level of illumination at 0.76 m (30 in.) above the deck. A height of 0.76 m was used to comply with DOD-HDBK-289 section 4.1.3. The procedure for mapping the illumination level consisted of mounting the photometer [Extech model number 401025] on a tripod to ensure a height of 0.76 m and mapping the space with multiple measurements to ensure complete coverage of the area. All portable obstructions, such as cabinets, were removed from the test space so no light was inhibited from entering the wide viewing angle (~180 degrees) of the photometer. Table 2 shows the average light level results of the photometric surveys done in each of the test compartments. The passageway had very low light levels because all surfaces were dark and covered with soot from previous fire tests.

Table 2 — Results of Photometric Surveys Inside Each Test Compartment

Test Compartment	Electronic Space	3rd Deck Magazine	2nd Deck Magazine	Operations Office	Passageway	PVLS
Average Illumination lux (Fc)	127 (11.8)	30 (2.8)	41 (3.8)	95 (8.8)	14 (1.3)	88 (8.2)
Standard Deviation +/- in lux (Fc)	38 (3.5)	12 (1.1)	18 (1.7)	32 (3.0)	11 (1.0)	88 (8.2)

4.3 Ventilation and Closures

Table 3 lists the door closures during testing. Generally, all doors were closed to isolate each compartment during tests. Mechanical ventilation was supplied to the 3rd deck magazine and passageway. All remaining compartments did not have mechanical ventilation. The ventilation supply and exhaust rates of each compartment were measured subsequent to testing. Supply and exhaust rates were measured at the corresponding fixtures and the overall flow through the compartment is reported as air changes per hour (ACH). Table 4 shows the measured ventilation rate through the 3rd deck magazine and 2nd deck starboard passageway. The air flow rate through the passageway was high and not typical for normal operations. The rate reflects smoke exhaust system operation. However, this flow rate was dictated by the same system that was used to supply the 3rd deck magazine. Due to the low light levels and the high air flow, the passageway provided a challenging location for detection to both video based and spot fire detectors.

Table 3 — Typical Compartment Closure Conditions during Testing

Door	Compartment	Condition during Testing
QAWTD 3-24-1	3rd Deck Magazine	Secured
QAWTD 3-29-1	3rd Deck Magazine	Secured
QAWDT 3-26-2	Electronics Space	Secured
NWTD 3-26-1	Electronics Space	Secured
QAWTD 2-22-4	2nd Deck Magazine	Secured
QAWTD 2-26-0	2nd Deck Magazine and Ops Office	Secured
WTD 2-27-0	2nd Deck Magazine	Secured
QAWTD 2-22-1	Operation Office	Secured
WTD 2-29-1	Starboard Passageway	Secured
WTD 2-24-1	Starboard Passageway	Secured
WTD 2-19-1	Starboard Passageway	Secured
WTD 2-17-3	Starboard Passageway	Secured
WTD 2-15-3	Starboard Passageway	Secured
QAWTD 2-17-1	Starboard Passageway	Secured
QAWTD 2-21-1	Starboard Passageway	Open
QAWTD 2-22-3	Starboard Passageway	Open
QAWTD 2-24-1	Starboard Passageway	Open
QAWTD 2-15-1	Starboard Passageway	Secured
WTD 2-22-5	Starboard Passageway	Open
QAWTD 2-26-1	Starboard Passageway	Secured
QAWTD 5-31-1	PVLS	Secured
QAWTD 3-31-1	PVLS	Secured

Table 4 — Measured Ventilation Rates in the 3rd Deck Magazine and 2nd Deck Starboard Passageway

Test Compartment	Ventilation Rates in ACH	Ventilation Rates in ft^3/min
3rd deck magazine	5	298
2nd deck starboard passageway	38	5320

4.4 Fire and Nuisance Sources

A variety of fire sources, nuisance sources, pipe ruptures and gas releases were used to expose the VSPs and spot-type detectors to a range of potential shipboard scenarios. Primarily small fires were used to challenge the detection systems and provide performance results for early detection. Tables 5 to 8 present details of the fire sources, nuisance sources, the pipe ruptures, and gas release scenarios, respectively. Most of the sources were positioned at deck level except the gas releases, which were generally at about 1.2 m above the deck. The height of the electrical cable fires and some nuisance sources (heat gun, radio, TV) were varied to provide both a range of test conditions and representative shipboard scenarios. Table 14 notes sources that were not placed on the deck and contains the height of the source above the deck. Pipe

ruptures and gas releases were simulated with a range of flow rates and leakage areas to challenge the VSP. Source locations can be seen in Figs. 4 and 6 through 10.

Table 5 — Fire Sources

No.	Fire Scenario	Description
1	Flaming cardboard boxes with polystyrene pellets	Configurations of two, four, and eight 0.26 x 0.26 x 0.11 m (10 x 10 x 4.5 in.) boxes are arranged in two parallel rows, with the 0.26 x 0.26 m (10 x 10 in.) sides facing the opposite row. The boxes are loosely filled with polystyrene packing pellets leaving approximately 2.5 cm (1.0 in.) of space to the top of the box. A 2.5 cm (1.0 in.) flue space is provided between the rows of boxes. A butane lighter is used to light the flap of one corner of a box half way up the flue space so that flames propagate up the flue space and involve both rows.
2	Flaming trash can	One 61 x 84 cm O.D., 32 L (24 x 33 in. O.D., 12-16 gal) plastic trash bag is approximately half filled with trash (20 crumpled paper towels, 20 crumpled tissues, three 16 oz plastic soda bottles, a 3 oz stick of deodorant, three cotton rags (36 x 36 cm (14 x 14 in.)) and a folded newspaper (10 full sheets). The trash bag is then placed in a metal trash can. The open bag of trash is lit at the top with a butane lighter.
3	Flaming shipping supplies	Three 4 L (1 gal) polyethylene bottles are placed on top of a 0.3 x 0.3 m (1.0 x 1.0 ft) section of wood pallet. Plastic shrink wrap is wound around this assembly three times. A 5 x 5 x 5 cm (2 x 2 x 2 in.) pan is filled with isopropyl alcohol (IPA) and positioned inside the pallet so that it impinges on both the wood slat and plastic bottles above. A butane lighter is used to ignite the IPA.
4	Flaming IPA spill fire	A 0.25 L (8.5 oz) spill of IPA on the deck is ignited with a torch. A bag of trash, as defined in the Flaming Trash Can scenario, is situated on the edge of the fuel spill. The bag of trash is intended to provide a sustained fire source in case the detectors do not alarm to the IPA spill fire alone.
5	Smoldering mattress and bedding	One 0.3 x 0.3 m (1.0 x 1.0 ft) section of Navy mattress (MIL-M-18351F(SH), 11 cm thick Safeguard polychloroprene foam core covered with a fire retardant cotton ticking) is under a stack of bedding, including one polyester batting, quilted mattress pad (Volunteer Blind Industries, GS-07F-14865, DDD-P-56E), one bed sheet (Federal Specification DDD-S-281) and one brown bedspread (Fed Spec DDD-B-151) (each 0.6 x 0.6 m (2.0 x 2.0 ft)). One 500 W cartridge heater (Vulcan, TB507A) energized at 85 VAC is located between the bedding and the mattress. If needed the voltage of the cartridge heater is raised to 100 VAC 15 minutes into the test and the cartridge is moved to virgin material. The 0.6 x 0.6 m bedding pieces are folded into quarters and placed on the mattress.
6	Smoldering cable bundle	A bundle of cable consisting of five 30 cm (12 in.) long pieces of Navy low-smoke cable (Monroe Cable Co., LSTSGU-9, M24643/16-03UN XLPOLYO cable) is placed in a horizontal orientation. One 500 W cartridge heater (Vulcan, TB507A) is placed in the middle of the bundle and energized to 84 VAC (70% of 120 V max). The power is increased to 100 VAC after approximately 25 minutes and further increased to 120 VAC 35 minutes after the power is initiated.

Table 5 — Fire Sources (Continued)

No.	Fire Scenario	Description
7	Smoldering laundry	Six cotton rags (36 x 36 cm (14 x 14 in.)) are folded into quarters and loosely piled one on top of another. The resulting footprint of the pile is 18 x 18 cm (7 x 7 in.). One 500 W cartridge heater (Vulcan, TB507A) is placed in the center of the pile and set to 96 VAC (80% of 120 V max).
8	Smoldering oily rags	Five cotton rags, approximately 36 x 36 cm (14 x 14 in.), each soaked with 30 mL (1 oz) of 10W30 motor oil are crumpled and tossed into a metal trashcan. One 500 W cartridge heater (Vulcan, TB507A) is inserted into a 2.5 cm (1.0 in.) diameter hole 2.5 cm (1.0 in.) from the bottom of the trash can and placed on top of one rag. The remaining rags are loosely piled on top of the heater. Using a variable transformer, the cartridge heater is energized to 85 VAC.
9	Painted bulkhead heating	The forward bulkhead of the test space is painted with one coat of white chlorinated alkyd enamel paint (DOD-E-24607A). A heptane spray fire in the aft, port corner of compartment 3-22-1 heats the painted bulkhead, causing the paint to off gas in the test space. Two industrial spray nozzles (Bete Fog Nozzles, model FF033) are connected to the heptane fuel system, which is pressurized to 47 psi.
10	Shielded IPA pan fire	A 0.3048 m by 0.3048 m (1ft x 1ft) pan with approximately 32 oz of IPA is placed in the interior of a metal cabinet, flush with the corner. When ignited, the flames from the pool fire heat the adjacent interior wall surfaces and the ceiling of the metal box.

Table 6 — Nuisance Sources

No.	Nuisance Scenarios	Description
1	Torch cut steel	A 0.6 x 0.6 m (2.0 x 2.0 ft) sheet of steel with 3 coats of chlorinated alkyd enamel paint (DOD-E-24607A) is cut with an oxyacetylene torch.
2	Welding	A 0.6 x 0.6 m (2.0 x 2.0 ft) sheet of steel with 3 coats of chlorinated alkyd enamel paint (DOD-E-24607A) is welded using an arc welder and 0.32 cm (0.125 in.) number 7018 rods.
3	Grinding painted steel	A 0.6 x 0.6 m (2.0 x 2.0 ft) sheet of steel with 3 coats of chlorinated alkyd enamel paint (DOD-E-24607A) is ground with an 11 cm (4.5 in.) power hand grinder.
4	Toaster: normal toasting	Four slices of white bread is toasted in a Magic Chef (model N-10) 120V, 1500W toaster at the darkest setting for two cycles.
5	Engine exhaust	Exhaust from a diesel-powered forklift engine (Yanmar, Engine #69914, engine output is 2.8 kW (3.8PS/3600), max output 3.1 kW (4.2PS/3600), displacement 0.199L) is allowed to flow into the test area.
6	People working in space	Multiple people work in view of the cameras. This work includes cleanup of water in the space and sweeping the deck as well as general test setup.
7	Waving materials	Waving a white cotton rag. The material is waved, shaken, and folded by a person moving through the space and stopping in front of each camera for a short period of time (minimum 30 sec).

Table 6 — Nuisance Sources (continued)

No.	Nuisance Scenarios	Description
8	Spray aerosol	A five second spray interval at multiple locations in the test space by two aerosols. The aerosols used are: 1) Old Spice High Endurance deodorant 2) Lysol disinfectant spray.
9	Spilling metal bolts	A bin of 1/4 in. metal bolts is spilled on the deck. The height of the drop is approximately waist high and the rate of spill is varied between slow (~5 bolts per second) to fast (all the bolts ~100 in 2 seconds).
10	Space heater	Operation of a one-setting Fostori Sun-mite space heater [model number SHK-212-1CA] at various locations.
11	Heat gun	A heat gun [Master heat gun make, and model HG-501A] is activated in 30-second intervals at multiple locations in the test space.
12	Flash photography	Flash photography is executed in the space, both in the view and out of the view of the cameras.
13	AM/FM radio	A radio is turned on and off and cycled through multiple talk and music stations.
14	VHF radio	Personnel with ship radios are walked through the test space while talking and receiving messages.
15	TV	A television in the test space is turned on with varying noise levels.

Table 7 — Pipe Ruptures

No.	Pipe Rupture Scenarios	Description
1	Water aerosol (Mist)	A water mist nozzle (Bete P24, k value of 0.0158) flowing at approximately 44-149 psig (0.105 to 0.193 gpm) is used to simulate a pressurized pipe puncture/fitting rupture.
2	Pipe rupture (gash)	A section of 2.5 cm diameter (1 in.) pipe with a gash (25 cm by 0.3175 cm (10 in. by 0.125 in.)) is oriented vertically and supplied with water at 61 psig.
3	Pipe rupture (open pipe)	Water is released from a 5.0 cm (2 in.) or 2.5 cm (1 in.) diameter pipe at 120 psig, replicating a severed vertical pipe.
4	Pipe rupture (sprinkler)	Water is released from a pipe with a sprinkler head (TF29-180-28, k value of 3.91) attached to disperse the water, replicating a fractured pipe. Water pressure is 60 psig and 120 psig.
5	Water mist system	7 AM4 nozzles are activated in the 2nd deck magazine and supplied with water at 250 psig.
6	Pipe rupture (9 holes)	A pipe with 9 ¼ inch holes in a 3 by 3 pattern was supplied with water at 250 psig.
7	Pipe rupture (small gash)	A section of 2.5 cm diameter (1 in.) pipe with a gash (5 cm by 0.3175 cm (2 in. by 0.125 in.)) is oriented vertically and supplied with water at 120 psig.

Table 8 — Gas Releases

No.	Gas Release Scenarios	Description
1	Gas release (N_2)	A Nitrogen tank with regulator supplies gas at 100 psig and 250 psig to 0.6 cm dia. (0.25 in.) copper tubing run into the compartment with the end of the tubing open to atmosphere and in some instances a 0.3 cm (0.125 in.) orifice was attached to the tubing.
2	Gas release (air)	An air hose with a release handle (manual valve) is used in the test compartment to release air into the compartment atmosphere. The line is pressurized to 120 psig.
3	Gas release (N_2) (small orifice)	A Nitrogen tank with regulator supplies gas at 100 psig to 0.6 cm dia. (0.25 in.) copper tubing terminating in a 0.6 to 0.16 cm (0.25 to 0.0625 in.) reducing fitting that discharges the gas directly to atmosphere.
4	SCBA	The valve on a self-contained breathing apparatus (SCBA) mask is released to allow free flow of gas into the atmosphere it can also be discharged in bursts.
5	Gas leak	A 70 m^3 (230 ft^3) bottle of Nitrogen is opened, releasing the gas with no regulator.

4.5 Prototype Volume Sensor Components

Eight prototype sensor suites were used in this test series. The sensor suites were placed at the locations in the test compartments shown in Figs. 4 and 6 through 10. The sensor suites were numbered 1 though 8. Table 9 provides the location of each VSP sensor suite. Appendix A contains images of the views from each of the eight sensor suites.

Table 9 — VSP Sensor Suite Locations

VS Suite No.	Compartment	Bulkhead	Height (from deck to shelf)	Distance from Adjacent Bulkhead to Shelf Center
1	Electronics space	Port Bulkhead	2.08 m (6 ft 10 in.)	1.5 m (5 ft) from Aft bulkhead
2	3rd deck magazine	Aft Bulkhead	2.16 m (7 ft 1 in.)	1.85 m (6 ft 1 in.) from starboard bulkhead
3	3rd deck magazine	Fwd Bulkhead	2.57 m (8 ft 5 in.)	0.81 m (2 ft 8 in.) from fwd bulkhead
4	2nd deck magazine	Aft Bulkhead	1.98 m (6 ft 6 in.)	1.78 m (5 ft 10 in.) from the port bulkhead
5	Operation office	Aft Bulkhead	1.88 m (6 ft 2 in.)	1.80 m (5 ft 11 in.) from port bulkhead
6	Operation office	Vestibule Fwd Bulkhead	2.03 m (6 ft 8 in.)	0.61 m (2 ft) from starboard bulkhead
7	Starboard passageway	Aft Bulkhead	2.0 m (6 ft 7 in.)	0.71 m (2 ft 4 in.) from port bulkhead
8	PVLS	OH	2.44 m (8 ft)	0.51 m (1 ft 8 in.) from port bulkhead and 2.44 m (8 ft) from the fwd bulkhead

Each prototype sensor suite included four components: a Closed Circuit Television (CCTV) video camera (cameras 1-8), a bullet camera with a long wavelength (near infrared) filter (cameras 9-16), a microphone, and a set of single element optical sensors, also known as a Spectral-Based Volume Sensor (SBVS) Prototype [14,15]. Data from the instruments in the prototype sensor suites were processed by the individual sensor subsystems of the VSP. These subsystems included a visible spectrum VID system, a long wavelength video detection system (LWVD), an SBVS detection system, and an acoustics detection system (ACST). The LWVD, SBVS, and VID systems were located in the bakery on the mess deck. The ACST system was located in the 3rd deck port side node room and in the 2nd deck starboard node room. The processed data and some pre-selected and normalized raw data was sent via the network from the subsystems to the FMs, the final component of the VSP located in the Control Room. Two VSPs were created to accommodate the two VID systems. The data produced by the smoke and fire alert (SFA) system was sent to the fusion machine (FM1) of VSP1, and the data produced by the SigniFire system was sent to the fusion machine (FM2) of VSP2. The rest of the sub-systems sent data to both fusion machines. The FMs provided further analysis using data fusion algorithms. The alarm information generated by the FMs constituted the primary output of the VSPs. The output from one of the VSPs then interfaced with the AFSS control system via simple text message passing. During week one of testing VSP2 (SigniFire) interfaced with the AFSS control system, during week two VSP1 (SFA) interfaced with the AFSS control system. The events reported by the VSP interfacing with the AFSS control system were displayed and used by the AFSS control system and shown on the Human-Computer Interface (HCI) workstations. Figure 11 shows a diagram and layout of the VSP system components and connections between them for data acquisition by the various sensors, data fusion, algorithm alarm generation, and output to the AFSS Control System.

Table 10 lists the VSP components and the general experimental setup for data acquisition. Figure 11 displays a diagram of the VSP and AFSS control system. Sections 4.5.1 through 4.5.5 describe the components of the VSPs and the AFSS control system employed in this test series.

4.5.1 Commercial VID Systems

Video cameras were used as part of the VSP and to monitor and record the conditions within the compartments during testing. The video images were obtained using standard charged coupled device (CCD) color cameras (Sony SSC-DC393) with a manual iris 3.5 to 8 mm variable focus lens (Pentex). Using a siamese cable (RG59 coax for video together with 18/2 for power), each video image was transmitted to an electronic distribution amplifier, which split the signal to five destinations:

1. SFA VID system;
2. SigniFire VID system;
3. Time-date generator followed by a digital video recorder (DVR) where applicable;
4. A Video Server to digitize and transmit the analog video across the Ethernet network to the AFSS control system; and
5. The control room, where a splitter divided the signal to each of the FMs and the test team video monitors.

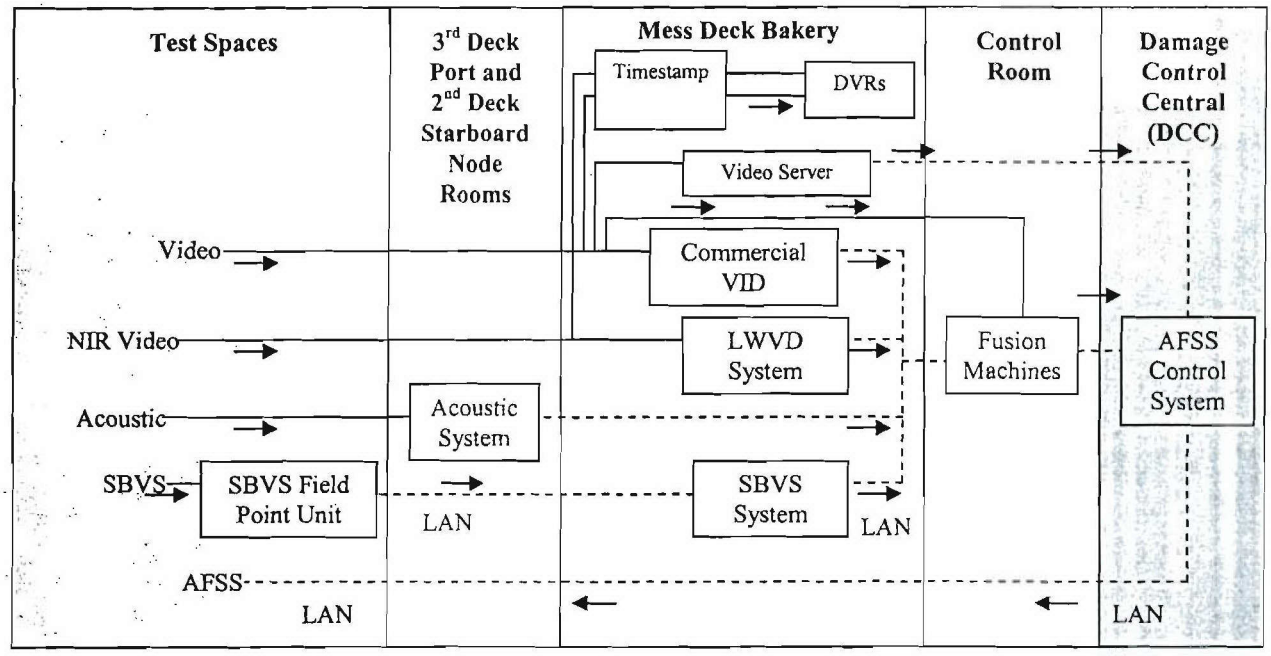

Fig. 11 — Diagram of VSP system components and LAN connections to the AFSS. Solid lines represent direct connections while dashed lines are LAN connections

Table 10 — VSP Components

Device/Instrument	Manufacturer/details	Data Acquisition
Volume Sensor multi-component prototype suite (Qty = 8)	Sony SSC-DC393 camera (8) Long wavelength NIR camera (8) Microphone (Shure MX-393 (7) and Shure MX-202 (1 (PVLS)) SBVS sensor suite (8)	Coax to splitters (VID) LWVD NRL 6110 equipment. Signal conditioning and laptop. NRL 7120 data acquisition and cables.
SFA Video flame and smoke detection system (Qty = 1)	Fastcom (version 1.1.0.600)	Independent PC receives 8 CCTV video inputs from splitters and produces digital output to VSP 1 via network.
SigniFire Video flame and smoke detection system (Qty = 1)	axonX (version 2.2.0.1436)	Independent PC receives 8 CCTV video inputs from splitters and produces digital output to VSP 2 via network.
Volume Sensor FM (Qty = 2)	PC with fusion alarm algorithms (1 system for each VID system)	Inputs from a VID system, SBVS sensor system, ACST system and LWVD system via network. Inputs from all eight standard CCTV video cameras for display.

It should be noted that due to the large number of cameras, (eight CCTV and eight near-infrared (NIR) cameras), only video from cameras in compartments containing test sources was recorded during each test. Figure 12 shows an example schematic of how a standard video image signal was split to the various components. The standard video cameras were powered via a

24 VAC supplies. The cable runs from the cameras to the splitters were direct runs onboard the ex-USS *Shadwell*. All the cable connections were made with BNC connectors.

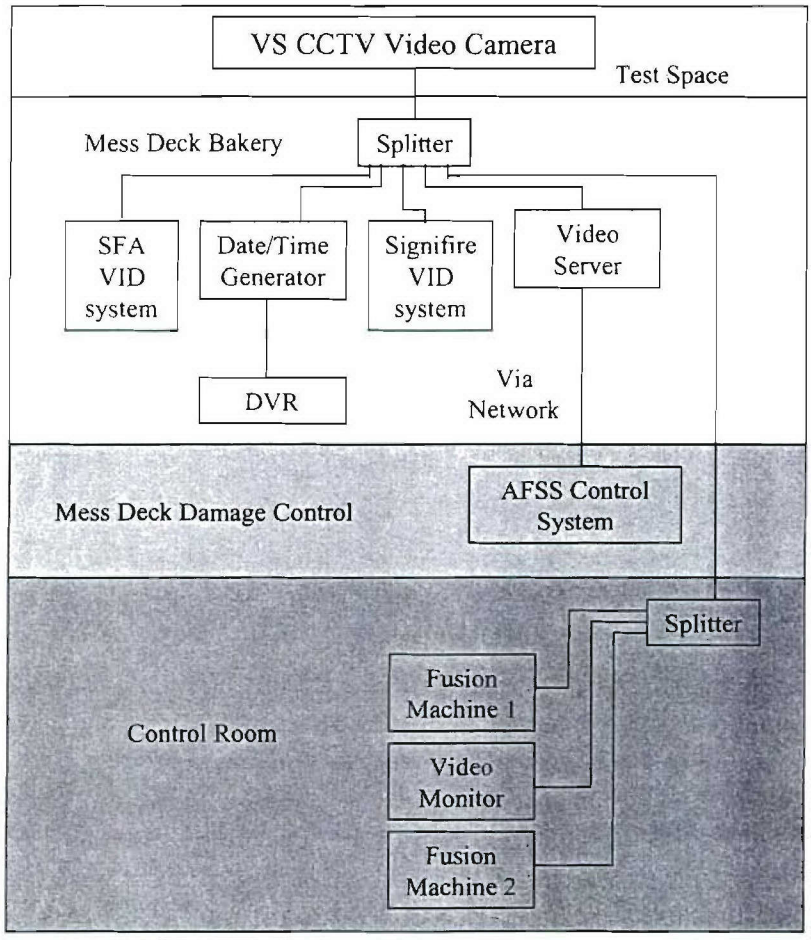

Fig. 12 — Example of standard video image routing diagram

Two commercially available VID systems were evaluated, one for each of the VSPs. Each system operated from an independent personal computer. Each VID system provided a digital output to the FMs via a local fiber optic Gigabit Ethernet network. The SFA system was installed on a standard Pentium 4 class PC running Microsoft Windows 2000. The SFA VID system was running version 1.1.0.600, which is the same version evaluated during VS4. The SFA system utilized both flame and smoke alarm algorithms to detect fires. The manufacturer uses the term "Fire" alarm to indicate flame detection.

The axonX SigniFire system was installed on a PC running Microsoft Windows XP. The axonX system was running the same version used during VS4, SigniFire version 2.2.0.1436. This system consisted of two flame algorithms and one smoke alarm algorithm. The flame algorithms consisted of one for fires that were directly in the field of view of the camera, and a

second "Offsite" algorithm detected fires outside the field of view. Both of the commercial VID systems used the same cameras incorporated into the VSP sensor suites.

Optimal camera settings were determined based on visual observation of the video image in conjunction with image metrics provided by the VID systems. The cameras were adjusted until the video image produced a maximum image quality value on the SFA system. The Signifire system was then auto adjusted to maximize the image quality. The cameras were optimized per VID manufacturer's recommendations. At the beginning of the test series each system was adjusted to establish an optimized image background.

Each VID system maintained an electronic history file of all alarms, including a digital photo (SFA) or movie (SigniFire) showing the video image that caused the alarm condition for each entry. The SFA and SigniFire systems provided for each historical image or movie, respectively, the time and date of the event, the alarm type, camera identification and file name. This allowed for a post-test review of each alarm to ensure that the event was due to a fire or smoke source and not due to an unintended source (false positive), such as participants moving around the compartment during a test.

4.5.2 Long Wavelength Video Detection (LWVD)

The LWVD system fielded for the VS5 test series is nearly identical to that employed for the VS3 and VS4 test series and described in [16]. The system was composed of a long wavelength camera, an analog to digital video converter, and data acquisition and analysis software that implemented a luminosity-based algorithm. The long wavelength cameras (i.e., CSi-SPECO CVC-130R (0.02 Lux) B&W cameras with a LP720 filter) were co-located with the video cameras as part of a VSP sensor suite. Each long wavelength video image was transmitted from the NIR camera to an electronic distribution amplifier, which split the signal to two destinations:

1. LWVD VID system, and
2. Time-date generator followed by a DVR, when applicable.

In the LWVD VID system, the video image was captured by a video analog-to-digital converter (Pinnacle, Studio Moviebox DV Version 9) and then made available to the data acquisition and analysis software through the Microsoft DirectX 9 Application Programming Interface (API). The video images were acquired and processed using the Naval Research Laboratory (NRL) LWVD software, which operated on eight PC(s) to process the eight NIR video streams (one per PC).

The original LWVD data acquisition and analysis program was written in the interpreted, prototype environment of Mathwork's Matlab v6.5 (Release 13) with the Image Acquisition Toolbox extension. Prior to the VS3 test series, the program was ported to Microsoft Visual Studio C++ .NET 2003. The C++ version of the LWVD software is functionally equivalent to the original version in terms of the mechanics of data acquisition and algorithmic processing. The C++ version additionally supports communication with a VSP fusion machine using the Volume Sensor Communication Specification (VSCS) protocol [17].

The LWVD software employed a luminosity-based algorithm for the detection of NIR emission [18]. For each incoming video image, the algorithm applied a simple non-linear threshold to the summed, normalized intensity difference of the current video image and a background image established at the start of each test. This algorithm was not altered for the VS5 test series; however, two new processing tools were added to the LWVD software for evaluation during VS5. The first was an alternative algorithm with a non-zero minimum threshold that simultaneously processed incoming video images. In the second, the pixel intensities were binned into a histogram with 25 bins once per second. The resulting time-dependent profile provides information that may be used to better identify regions of slowly increasing luminosity in the video image, like the bulkhead heating associated with adjacent compartment fires. The output of both algorithms was recorded locally in log files for later evaluation.

4.5.3 SBVS Component Prototype

The SBVS Component Prototype is described elsewhere [19] and is only discussed briefly here. Each SBVS Component Prototype was composed of two units, the VIS/IR unit and the UV unit. The VIS/IR unit contained three Si photodiodes (PDs) with interference filters centered at 5900, 7665, and 10500 Å. A mid-IR (IR) detector was installed for operation at 4.3 μm. The UV units were designed around a standard UV gas discharge tube and electronics (Vibrometer, Inc.). The OmniGuard 860 Optical Flame Detector (Vibrometer, Inc.) that was used in the SBVS Testbed contained the same UV sensor unit and was deployed as the UV unit for sensor suite number 1. As outlined in a previous report [8], a distributed-architecture data acquisition system was designed and implemented for the SBVS Component Prototype of the VSP using the Fieldpoint line (National Instruments) of data acquisition equipment. Three Fieldpoint Units were distributed throughout the test spaces to provide the necessary coverage.

Event detection algorithms for five event classes were implemented for real-time use [20]. These events were: EVENT, PDSMOKE, FIRE, FIRE_FOV, and WELDING. The EVENT was conceived of as a generic trigger, and indicated that some, currently unclassifiable, event was occurring in the field-of-view (FOV) of the sensor. The PDSMOKE event made use of long-time-scale deviations observed in the 5900 Å channel data that were not correlated with flaming events to detect and classify smoke within the sensor FOV. The algorithms for FIRE and FIRE_FOV detection compared the pattern of measured channel values for the five sensors-or spectrum-to an empirically determined spectrum for a fully involved flaming fire in the sensor FOV for the FIRE_FOV event, or to a more general spectrum for the FIRE event. An algorithm for the positive detection of one type of nuisance, arc welding, was also included. All raw channel data were recorded locally on the SBVS Component data acquisition computer. Baseline-subtracted and normalized sensor channel data and algorithm outputs were forwarded to the Fusion Machines using the VSCS protocol. Individual unit calibrations were implemented after the VS3 test series for the SBVS hardware in each sensor suite to allow for unit-to-unit variations in response sensitivity.

4.5.4 Acoustic System

A microphone was placed at each sensor suite location to measure the acoustic emissions from the pipe ruptures, fires, nuisance, and other sources. The microphones had a 50-17,000 Hz frequency range and were connected directly to an acoustic processing system. There were two such systems, called ACST1 and ACST2, each capable of handling four microphones. Each system provided DC power to drive the microphone pre-amplifiers from an internal phantom power supply. There was no hardware gain adjustment; this was done by the data acquisition and analysis software. The signal passed to a 24-bit D/A card for data acquisition and processing by a Pentium-M computer also internal to the system. The computer program monitoring the microphones started automatically when the processing system was powered up, but could also be stopped and started remotely over the network. Once started, control passed to the VSP fusion machines, which started and stopped the actual data acquisition and processing through XML command messages. All acoustic data was stored to disk files according to the start and stop commands from one of the fusion machines. Processing of the data was done in real-time, and the status of the event criteria was provided in VSCS format to the VSP fusion machines via the fiber optic gigabit network.

The acoustic systems used a combination of spectral-feature algorithms and linear discriminate analysis (LDA) to determine the type of event present. According to the events being considered the two methods could work in conjunction, or independently. For the LDA, a set of parameters was calculated based on the spectrum and the time-series. The parameter set included a number of features describing the spectrum, its shape, variation, lines and transients over a 5 second time interval. At each reporting interval, the current parameters were used to calculate predictions for nine types of events, which were then converted to probability estimates. Each probability was averaged over time, if it remained above a threshold for a sufficient period of time the alarm level reached 1 and an alarm was formally declared by the ACST system. The LDA algorithm did not rely on background averaging, as was used for the feature algorithms and was expected to detect a water event immediately preceded by a noise event of some other type. The current state of the acoustic processing systems was fully available to the VSP fusion machines at all times, since both channel data and alarm data for all algorithms was sent when requested by a START command.

A spectral-feature algorithm was used to accelerate the pipe rupture alarm. It operated independently from the LDA and examined the spectrum in the range 7-17 kHz. If the level rose sufficiently above the background average it examined it for near-linearity over the band. If it was both linear and stable in time a pre-event alert state was set. As it remained elevated for a sufficient time the alert level was increased above 0. As for LDA, if it reached 1, an alarm was issued. The higher of the two alarm levels (LDA and spectral-feature) was reported to the VSP.

4.5.5 Volume Sensor Prototype Fusion Machines

Two VSPs were used in this test series. Both prototypes used the same LWVD, ACST, and SBVS detection systems while using different VID systems. One prototype employed the Fastcom SFA commercial VID system; the other prototype used the axonX SigniFire commercial

VID system. Two custom-built PCs with AMD Opteron 64-bit processors were used as FMs to implement data fusion algorithms for each prototype. Volume Sensor Prototype 1 (VSP1) analyzed data from the SFA, LWVD, SBVS, and ACST sensor subsystems. Volume Sensor Prototype 2 (VSP2) analyzed data from the SigniFire, LWVD, SBVS, and ACST sensor subsystems.

Control of the sensor subsystems, as well as the graphical user interface for each prototype, was implemented separately in software programs running on each FM. These programs were referred to as the command and control (CnC) and graphical user interface (GUI) programs, respectively, and worked together to process, display and log data from the components of the prototypes. The CnC software implemented the VSCS protocol of XML message packets sent via user datagram protocol (UDP) over the ship's transmission control protocol/internet protocol (TCP/IP) network that controlled the sensor subsystems and gathered their data to the FM at one-second intervals. Details of the protocol are available in reference [17, 21]. The software of the data fusion algorithm module (DFAM), implemented as an internal class library of the CnC software, performed the processing of the sensor data. The GUI software displayed the data from the sensor subsystems and data fusion algorithms, and also provided an interface for human control of the VSP. Further documentation on the CnC and GUI software is in references [21-23]. The CnC and GUI software generated several log files to record the incoming and processed sensor data, and the event history of each test. The CnC software maintained a sequential log file recording all command and control events and sensor data packets received. The CnC software also created a separate "replay" log file for each test that can be used to replay the test on a FM at a later date. This feature can be used for post-processing of refinements to the data fusion algorithms and for off-line debugging of the CnC/GUI interface. The GUI software also logged all data packets received from the CnC software, and all user interactions.

The DFAM software was restructured for the VS5 test series to better accommodate a more complex and flexible layout of sensor suites in multiple compartments. Three C++ classes were developed for this purpose: (1) the sensor suite object, (2) the data fusion object, and (3), and the DFAM object. These three classes constituted the entire data fusion software implementation. The sensor suite object encapsulated the data from all sensors in an individual VSP sensor suite, parsed the sensor data in the CnC sensor gestalt format, and repacked the data into the DFAM format for data fusion analysis. A sensor suite object also logged all its sensor data sequentially to a local log file. The data fusion objects performed and encapsulated the data fusion analysis for collections of sensor suite objects and also logged all their fusion information sequentially to local log files. The DFAM object served as the interface with the CnC software, receiving new sensor data, passing it through the sensor suite and data fusion objects, and returning the results of the fusion analysis to the CnC for transmission to the GUI and AFSS programs.

The fusion analysis classified sensor suite data into six event categories: flame, smoke, water, thermal, gas release, and suppression system. The data fusion objects used for the fusion analysis are described in Table 11. One data fusion object performed the fusion analysis for each of the six compartments described in section 4.1. Four additional data fusion objects performed fusion analysis on selected sensor suites within the 3rd deck magazine and operations office compartments to help evaluate the performance of the VSPs with fewer sensor suites per

compartment. The output from data fusion objects 1 – 5 was compiled and passed by the DFAM object to the CnC software for transmission to the VSP GUI display system and the AFSS supervisory control program.

Table 11 — Breakdown of VSP data fusion analysis: input sensor suites, compartments, and output destinations

Data Fusion Object	Input Sensor Suites	Compartment	Output Destinations
1	VS #2, VS#3	3rd Deck Magazine	AFSS, GUI, Log
2	VS #4	2nd Deck Magazine	AFSS, GUI, Log
3	VS #5, VS #6	Operations Office	AFSS, GUI, Log
4	VS #7	2nd Deck Starboard Passageway	AFSS, GUI, Log
5	VS #8	Peripheral Vertical Lauch System	AFSS, GUI, Log
6	VS #1	Electronics Space	Log only
7	VS #2	3rd Deck Magazine	Log only
8	VS #3	3rd Deck Magazine	Log only
9	VS #5	Operations Office	Log only
10	VS #6	Operations Office	Log only

New and modified data fusion algorithms were incorporated into the fusion analysis for the VS5 test series. Gas release and suppression algorithms based on new event classes from the ACST sensor system were added to the decision tree. Nuisance detection capabilities were augmented by the ACST grinding event class. Nuisance blocking of data fusion flame and smoke alarms was altered to take advantage of the dynamic sensing capabilities of the Volume Sensor. The flame and smoke detection capabilities of a data fusion object were restored two minutes after the cessation of a fire-like nuisance source, such as welding or grinding. Sensitivity to simultaneous sources was maintained for all other event classes. The ability to communicate with individual sensor systems via VSCS message passing was also added to the data fusion algorithms and used to clear flame and smoke alarms on the commercial VID systems caused by a fire-like nuisance source.

One of the objectives of this test series was to demonstrate the integration of the VSP into the shipboard DC environment. To accomplish this objective, the DD(X) engineering development model (EDM) AFSS was modified to accept information from the VSPs. The AFSS received the same data stream from the FM CnC program as the corresponding VSP GUI program. This demonstration continued to expand the generality and scalability of the overall VS concept from the subsystems through the higher-level command and control hierarchies of the AFSS control system.

4.6 Automatic Fire Suppression System (AFSS)

The DD(X) AFSS control system installed on the *Shadwell* represents a functional prototype of the device-level layer of the envisioned DD(X) Flight I AFSS control system [24]. The system's automated response to damage events, including fires, fluid system ruptures, and device failures was achieved by the collaboration and interaction that occurred between AFSS devices that reside in the lowest layer of the AFSS control system. The set of these intelligent devices included smart valves, activation valves, smart pump controllers, and fire and smoke detectors that send and/or receive processed data messages via a distributed control network (DCN). The installed DCN consists of a 10/100 BaseT Ethernet backbone connecting eight (8) port and starboard Ethernet switches [24]. A combination of LonWorks *subnets* and either network-capable video cameras or standard analog cameras are then connected to the DCN via the Ethernet switches. This arrangement provides the envisioned interfaces and functionality of the Total Ship Computing Environment Infrastructure (TSCE-I), which is the ship-wide network present in the DD(X) Flight I design [24].

The VSP system was incorporated into the AFSS control system, replacing the fire and smoke detectors that were evaluated during DDX EDM tests [25]. The VSP system provided an expanded set of responses over conventional fire detectors with alarms to smoke, flame, pipe ruptures, and gas releases. The VSP system also supplied real time color video from the VSP sensor suite CCTV cameras via Axis video servers (241 series).

The installed AFSS control system incorporated some of the human-system interface (HSI) functions expected to be present in the DD(X) Flight I design [24]. This higher-level, HSI functionality was provided by a High-level Software Module (HLSM) that executes across four HCI workstations. Each workstation provided a situational awareness display from which an operator may monitor and remotely control the AFSS.

The HCI workstations, installed in DCC, DC Repair Locker No. 2, DC Repair Locker No. 3 and the Ship Control Room, were also connected to the AFSS DCN via the Ethernet switches described above. The HCI workstation installed in DCC, called the Secondary Ship Mission Center (SSMC) for DD(X), communicates *peer-to-peer* with all AFSS devices and serves as the mediator between the AFSS devices and the DC Repair Locker and Ship Control Room HCI workstations.

All AFSS devices, except for the video cameras, can interact with other AFSS devices and/or the HLSM using LonWorks messages that are transmitted via the DCN. The AFSS control system was upgraded to interface with the VSP system and accommodate the CCTV cameras at each VSP sensor suite. The AFSS control system displayed the alarm conditions from the VSP system and identified the specific location the alarm was occurring on the ship. Once an alarm condition was noted, the control system automatically displayed video for the affected spaces. The displays, along with the other AFSS sensor information that was available, were accessible at all HCI workstations as noted above. The AFSS autonomic DC functions were secured during the VS Test Series. Detection functions were operational and logged for later analysis.

4.7 Shipboard Setup

Because of the experimental nature of this program, there were a number of computers used to operate the VSP and to store and document the individual sensor and subsystem data and video. The systems used to run the VSPs are itemized below:

1. SFA Field Unit;
2. SigniFire Field Unit;
3. Fusion Machine 1;
4. Fusion Machine 2;
5. Acoustic system;
6. SBVS System; and
7. LWVD System.

The majority of the systems processing hardware was located on the mess deck in the bakery. The bakery housed the ten DVRs, the two VID systems, and the AFSS video server. The LWVD and the SBVS systems were integrated into eight of the ten DVR computers. The acoustic processing and data acquisition systems were located in the 3rd deck port and 2nd deck starboard node rooms. The Field Point units for the SBVS system were located on the 2nd and 3rd decks. One Field Point unit was in the operations office accommodating the starboard passageway and operations office SBVS test beds. One Field Point unit was located in 3rd deck magazine to accept the 3rd deck magazine and electronic space SBVS test beds, and the final field point unit was located above the PVLS overlooking the well deck and received the 2nd deck magazine and PVLS SBVS test beds. The two FMs were located in the Control room. The HCI workstation called the SSMC was located in the DCC on the mess deck. Table 12 provides a summary of the wire and cable runs used.

4.8 Instrumentation

In addition to the VSP suites, instrumentation (see Table 13) was installed throughout the test compartments to measure temperatures and smoke density. The measurements were not directly utilized by the VSPs; however, they provided general space conditions and benchmarks for typical spot-type fire detection systems. Sections 4.8.1 through 4.8.3 provide details of the instrumentation that was used for these measurements. The locations of the instrumentation are shown in Figs 13 through 15. Figures 13 and 14 show the locations of the TCs, ODMs and smoke detectors on the 3rd deck. The TC, ODM, and detector locations on the 2nd deck are detailed in Fig. 15.

Table 12 — Cable Runs

Type of Wire/Cable	Number of Runs	Description
Coax video line	16	From each of the 8 CCTV cameras and from each of the eight NIR cameras to the bakery (note CCTV and NIR cameras are collocated at each VS suite location).
Coax video line	8	From the bakery to the Control Room for Test Team video.
Coax video line	5	From Control Room to reach each of the test compartments to supply video of the test sources. The same camera was used for the 3rd deck magazine and the electronics space. (These cameras were not used by the VSP).
Microphone cable	4	From the 3rd deck node room to sensor suite locations 1-4.
Microphone cable	4	From the 2nd deck node room to sensor suite locations 5-8.
Network drop	1	In the bakery for each of the VSP systems.
Network drop	1	In the Ops Office for the Ops Office and passageway SBVS systems.
Network drop	1	In the 3rd deck mag. for the 3rd deck mag and elect. space SBVS systems.
Network drop	1	Above the PVLS for the 2nd deck mag and PVLS SBVS systems.
Network drop	1	In the control room (one for each VSP fusion machine).
Network drop	1	In the 2nd deck starboard node room for ACST system.
Network drop	1	In the 3rd deck node room for ACST system.

Table 13 — Instrumentation

Device/Instrument	Manufacturer/Details	Data Acquisition
Ion detector (Qty = 7) Photoelectric detector (Qty = 7) Multi detector (Qty = 7)	EST SIGA-IS EST SIGA-PS EST SIGA-IPHS	EST3 Panel Individual alarms monitored via 24 panel output relays to Masscomp.
Laser ODM (Qty = 9)	880 nm infrared LED and receptor over a 1.0 m (3.3 ft) path length	Masscomp
Overhead gas thermocouples (Qty = 6)	Type K, bare bead	Masscomp
Air thermocouples (Qty = 27)	Type K	Masscomp
Fwd Blkhd thermocouples (Qty = 5)	Type K	Masscomp

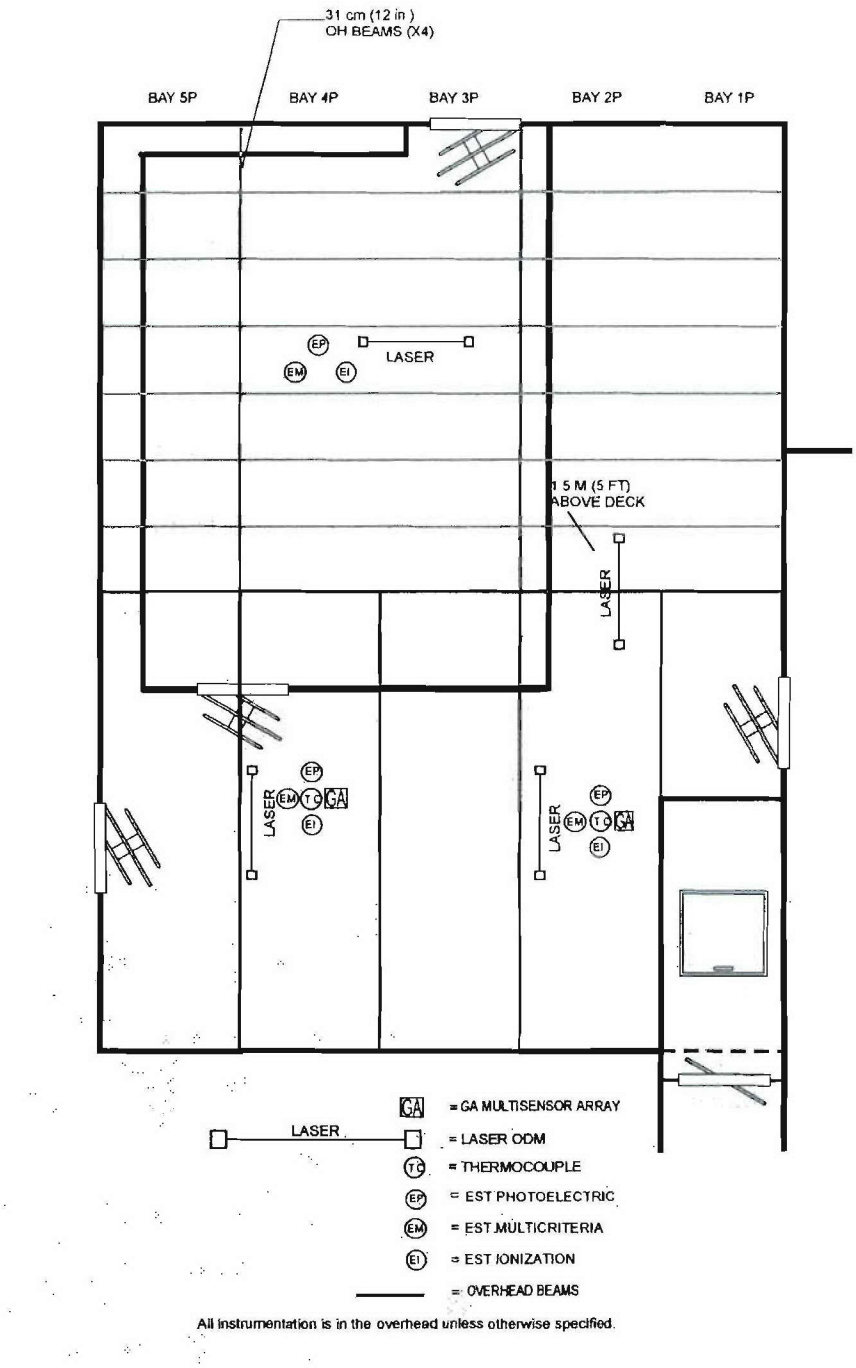

Fig. 13 — Layout of ODMs and spot-type detectors in the 3rd deck magazine

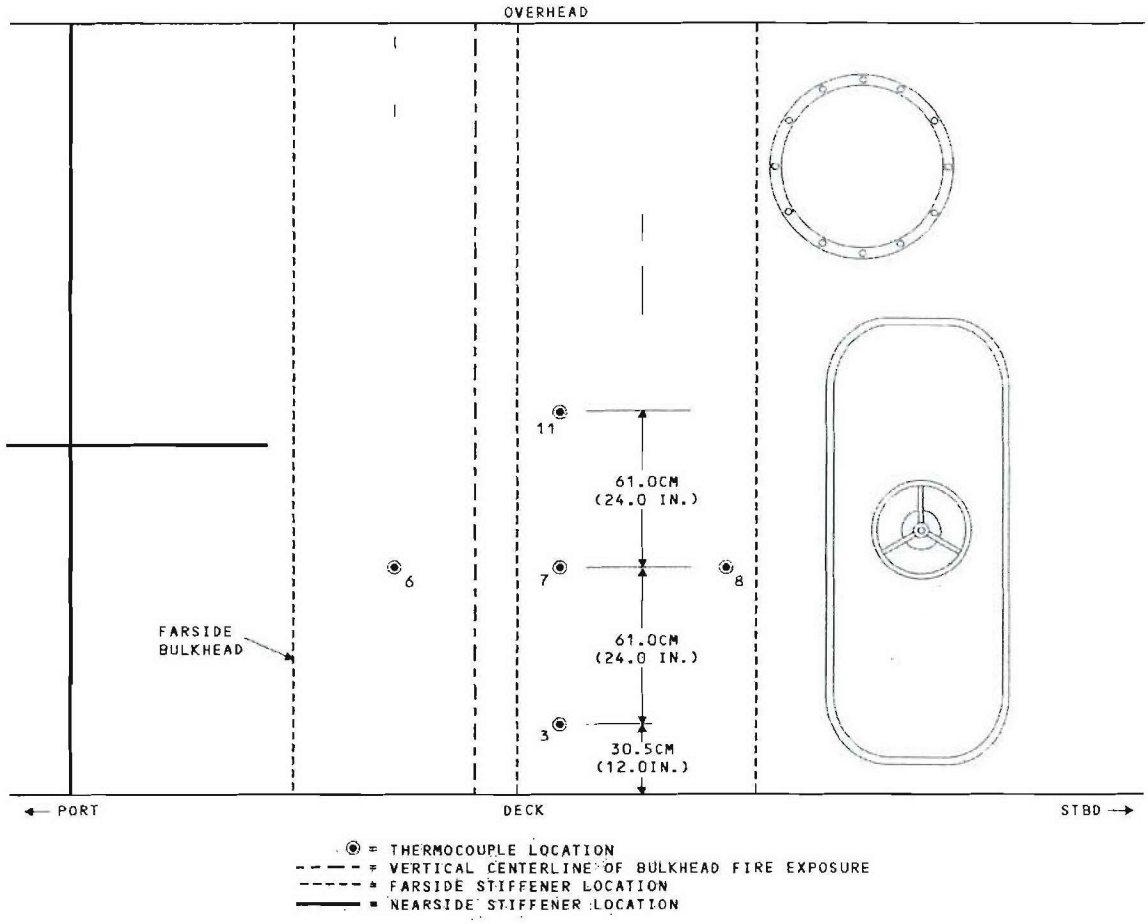

Fig. 14 — Locations of 3rd deck magazine forward bulkhead thermocouples

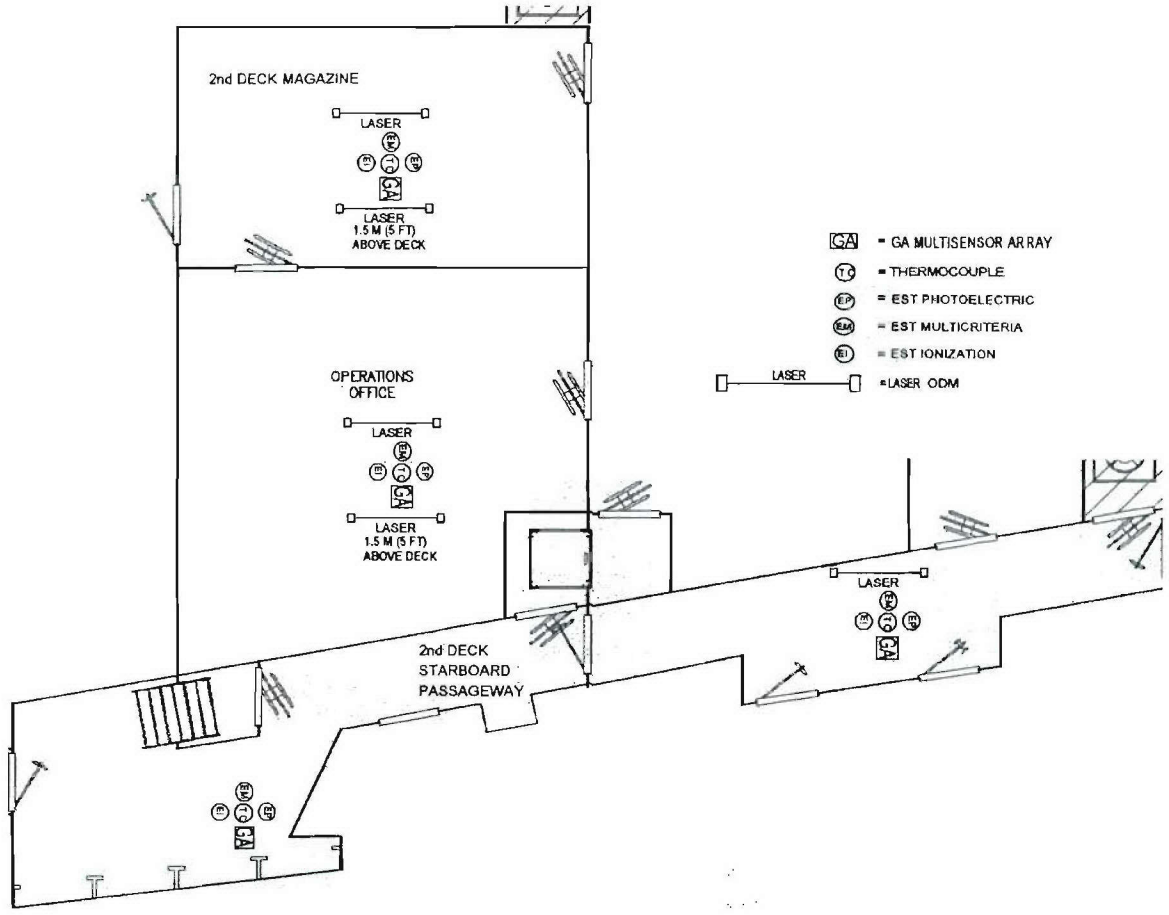

Fig. 15 — Locations of ODMs and spot-type detectors in 2nd deck test compartments

4.8.1 Optical Density Meters

Smoke obscuration was measured using ODMs. The ODMs consisted of an 880 nm infrared (IR) light emitting diode and receptor arrangement over a 1.0 m (3.3 ft) path length. The ODMs were positioned adjacent to each grouping of spot-type smoke detectors, excluding the passageway. One ODM was positioned in the center of the operation office, 2nd deck magazine, 3rd deck magazine and below the fwd passageway detector cluster at a height of 1.5 m (5 ft) above the deck.

4.8.2 Thermocouples

The overhead air temperatures adjacent to the detectors were measured using 1.59 mm (0.0625 in.) Type K, inconel sheathed thermocouples. A thermocouple was placed next to each detector cluster, excluding the detector cluster in the electronics space. The thermocouples were positioned at the approximate height of the detector heads, 10 cm (4 in.) below the overhead. The forward bulkhead of the 3rd deck magazine was instrumented with five thermocouples to

map the steel temperature during the painted bulkhead heating scenario. The thermocouple locations on the 3rd deck magazine bulkhead are detailed in Fig. 14. Thermocouple trees were also used to measure compartment air temperatures. Each tree consisted of three Inconel-sheathed, type K thermocouples positioned 0.30 m (1.0 ft), 1.5 m (5.0 ft), and 2.7 m (9.0 ft) above the deck. Three TC trees were located in the passageway, one TC tree was located in the operations office and one TC tree was located in the electronic space. Two TC trees were located in the 2nd deck magazine and Two TC trees were located in the 3rd deck magazines.

4.8.3 Detectors

The VSP results were compared to COTS smoke detection systems as outlined in Ref. [26]. Seven COTS Edwards System Technologies (EST) spot-type ionization, photoelectric, and multi-criteria detection systems were installed in clusters as shown in Figs. 13 and 15. The ion, photo, and multi-criteria smoke detection systems were used as the primary benchmark for assessing the performance of the VSP. All similar spot-type detectors were considered part of a system for a given test compartment. For instance, if any of the two EST ionization detectors installed in the 3rd deck magazine alarmed, then the EST ion system for that compartment was considered to have alarmed. The EST detectors were re-initialized before each test using a computer software program provided by EST and installed on a laptop. All ionization, photoelectric, and multi-criteria detectors were used at their "Normal Sensitivity" setting. These settings correspond to 2.9% obsc/m (0.9% obsc/ft) for the EST ionization detectors and 8.0% obsc/m (2.5% obsc/ft) for the photoelectric and multi-criteria units. These sensitivity levels are consistent with the recommendation of the manufacturer for shipboard use in past test evaluations.

The detectors in the 3rd deck magazine were located in the center of the starboard sections of bay 2 and the starboard section of bay 4, as seen in Fig. 13. The operations office, 2nd deck magazine, and electronics space contained one cluster of spot-type detectors located in the center of the compartments. The starboard passageway contained two detector clusters one in the fwd section and one in the aft section of the passageway. No Spot type detection was used in the PVLS. The AFSS autonomic suppression logic was secured to prevent accidental discharge of the suppression system. General Atomics (GA) MuHisensor array was included in the test series, but is not discussed here. The results are the subject of another report.

4.9 Test Procedure

The general test procedure was to assure that all equipment was operational and that all system clocks were synchronized. The test was then conducted. Once the testing was complete, the compartment was ventilated and, when cleared, the next test begun. The procedure included an overall system check and establishment of a clean baseline for all systems between tests. The EST detectors were re-initialized before each test using the computer software program provided by EST. For each test, the various systems were started and allowed to collect background data for a minimum of 300 seconds. After the background data was collected, the sources were initiated and allowed to continue until fully consumed or until all systems were in alarm or showed no change in detection due to quasi-steady state conditions.

4.10 Test Matrix

Table 14 provides a summary of the tests conducted. Source locations can be seen in Figs. 4 and 6 through 10. The test matrix was designed to provide a range of event sources and source locations to comprehensively evaluate the detection systems. The portion of the test matrix dedicated to evaluating the nuisance source immunity of the VSP aimed to provide worst-case nuisance scenarios in terms of source location. That is, the sources were generally close to the sensors or within direct line of sight of the cameras. Nuisance source tests were chronologically interspersed with the fire, rupture (fluid flow), and gas release tests.

The test matrix evaluated a number of realistic scenarios in a range of test compartments. The 2nd deck magazine, 3rd deck magazine, operations office, and 2nd deck passageway constituted the primary test spaces for the majority of test scenarios, with additional test sources in the PVLS and electronics space. In Table 14, the compartment and source location of each source are listed. The compartment abbreviations correspond to 2nd deck magazine (2nd Deck), 3rd deck magazine (3rd Deck), operations office (Ops), passageway (Pway), PVLS, and electronics space (ES). Unless otherwise noted, the source was conducted on the deck.

5.0 MEASURES OF PERFORMANCE

The measures of performance that were used to evaluate the performance of the VSP systems are:

1. The ability of the VSPs to operate in multiple compartments.
2. The ability of the VSPs to discriminate sources in compartments varying in size, shape, and content (obstructions).
3. The ability of the VSPs to discriminate multiple events occurring consecutively within a compartment or simultaneously in multiple compartments.
4. The ability of the AFSS control system to successfully integrate with the VS system.
5. The percent correct classification of sources for each of the detection systems.
6. The speed of response to fire sources, comparing response times for the VSPs to the COTS spot-type detectors.

Table 14 — Test Matrix for VS5 Test Series

Test ID	Location (height)	Description	Start Data Collection	Source Initiation	Source Transition	Source Termination	Data Collection Stopped	Event Type
VS5_001	3rd Deck-3	4 Flaming cardboard boxes with PS	11:12:00	11:17:28		11:25:30	11:28:00	Flaming
	2nd Deck-7	Torch cutting steel		11:18:00		11:26:09		Nuisance
VS5_002	2nd Deck-7	Flaming trash can	13:49:00	13:54:02		14:04:00	14:04:00	Flaming
	Ops-11	Welding		13:54:02		14:00:38		Nuisance
	2nd Deck-8 (1.2m)	Gas release (air bursts)		14:01:30		14:02:35		Gas release
VS5_003	Ops-13 (1.2m)	Heat gun	14:31:30	14:36:30		14:39:38	14:46:00	Nuisance
	2nd Deck-8 (1.2 m)	Gas release (N_2, 100 psig)		14:36:30		14:37:40		Gas release
	Ops-12 (OH)	Water Aerosol (mist, 60 psig)		14:40:30		14:46:00		Pipe rupture
VS5_004	Ops-11	2 Flaming cardboard boxes with polystyrene pellets	9:22:00	9:27:00		9:33:25	9:38:30	Flaming
	3rd Deck-5	2 Flaming boxes with polystyrene pellets		9:28:00		9:38:30		Flaming
	Ops-13 (1.2 m)	Pipe rupture (gash, 40 psig)		9:34:00		9:36:48		Pipe rupture
VS5_005	2nd Deck-7	Smoldering oily rags	10:36:00	10:41:32		10:55:05	10:55:30	Smoldering
	3rd Deck-4 (1.2 m)	Pipe rupture (gash, 60 psig)		10:41:32		10:43:10		Pipe rupture
	Ops-13 (OH)	Pipe rupture (mist, 60 psig)		10:45:00		10:54:12		Pipe rupture
VS5_006	Ops-12	Smoldering laundry	12:06:00	12:11:00	12:18:00	12:21:15	12:26:00	Smoldering
	3rd Deck	People working in space		12:12:00		12:26:00		Nuisance
	Ops-13 (OH)	Pipe rupture – sprinkler 60 psig		12:22:00		12:24:00		Pipe rupture

Table 14 — Test Matrix for VS5 Test Series (Continued)

Test ID	Location (height)	Description	Start Data Collection	Source Initiation	Source Transition	Source Termination	Data Collection Stopped	Event Type
VS5_007	3rd Deck-4	Smoldering cable bundle	13:07:00	13:12:00	13:37:50	13:48:50	13:49:30	Smoldering
	Pway-16	IPA spill fire		13:13:27		13:28:30		Flaming
	3rd Deck-5 (1.2 m)	Gas leak		13:30:30		13:32:30		Gas release
VS5_008	Ops-13	Flaming shipping supplies	14:17:00	14:22:00		14:33:00	14:34:00	Flaming
	3rd Deck-3	Flaming trash can		14:23:00		14:34:00		Flaming
	Ops-11 (1.2 m)	Gas release (N_2, 100 psig)		14:28:30		14:32:35		Gas release
VS5_009	3rd Deck-2	IPA spill fire	10:21:00	10:26:00		10:38:00	10:37:30	Flaming
	Ops-23 (1.2 m)	Toaster (normal toasting)		10:27:58		10:33:38		Nuisance
	3rd Deck-5 (1.2 m)	SCBA		10:35:00		10:36:15		Gas release
VS5_010	Ops-23 (1.2 m)	TV	11:53:00	11:58:00		12:46:00	12:46:00	Nuisance
	Ops-12	Smoldering cable bundle		12:21:30		12:46:00		Fire scenario
	3rd Deck-5 (1.2 m)	Gas release (N_2,100 psig)		12:24:00		12:25:19		Gas release
VS5_011	3rd Deck-5	Torch cutting steel	13:49:00	13:54:27		13:59:04	14:01:15	Nuisance
	Ops-13	Pipe rupture – open pipe,120 psig		13:55:00		13:57:00		Pipe rupture
VS5_012	2nd Deck-8	Grinding painted steel	14:27:00	14:32:08		14:37:08	14:49:00	Nuisance
	Ops-10	Smoldering oily rags		14:38:30		14:49:00		Smoldering
	2nd Deck-7	Flaming cardboard boxes with polystyrene pellets		14:37:50		14:42:05		Flaming
VS5_013	Ops-13	Welding	8:45:00	8:50:00		8:56:30	9:02:30	Nuisance
	2nd Deck-7	Smoldering laundry		8:50:00		8:58:45		Fire scenario
	Ops-13	IPA spill fire		9:00:34		9:02:30		Flaming

Table 14 — Test Matrix for VS5 Test Series (Continued)

Test ID	Location (height)	Description	Start Data Collection	Source Initiation	Source Transition	Source Termination	Data Collection Stopped	Event Type
VS5_014	3rd Deck-1	Space heater	9:30:00	9:35:30		9:42:05	9:55:00	Nuisance
	Pway-14 (1.2 m)	Gas release (air)		9:35:00		9:38:25		Gas release
	3rd Deck-1	Smoldering laundry		9:42:00		9:55:00		Fire scenario
VS5_015	Ops-13	Grinding painted steel	10:43:00	10:48:00		10:53:50	11:10:05	Nuisance
	2nd Deck-8	Flaming shipping supplies		10:48:00		10:56:45		Flaming
	ES-17	Flaming trash can		10:49:30		10:56:45		Flaming
	Ops-13	Smoldering cable bundle		10:54:10		11:10:05		Smoldering
VS5_016	2nd Deck-7 on cabinet	Toaster (normal toasting)	12:12:00	12:17:00		12:21:40	12:31:00	Nuisance
	ES-18 (on sub-floor frame)	Smoldering cable bundle		12:18:30		12:31:00		Smoldering
	PVLS Deck-15	4 Flaming cardboard boxes with PS		12:17:00		12:31:00		Flaming
	2nd Deck-8	Smoldering mattress and bedding		12:21:53		12:27:50		Smoldering
VS5_017	3rd Deck-3	AM/FM radio	13:11:00	13:16:00		13:42:00	13:42:00	Nuisance
	Pway-14	Flaming trash can		13:16:00		13:28:55		Flaming
	Ops-13	Smoldering mattress		13:19:00		13:27:20		Smoldering
	3rd Deck-5	Smoldering oily rags		13:23:00		13:42:00		Smoldering
VS5_018	Ops-11	Welding	14:14:00	14:19:00		14:25:30	14:33:40	Nuisance
	3rd Deck-1	Shipping supplies		14:19:00		14:33:40		Flaming
	Pway-14	People in space		14:21:00		14:33:40		Nuisance
	Ops-13	Flaming trash can		14:26:30		14:33:40		Flaming

Table 14 — Test Matrix for VS5 Test Series (Continued)

Test ID	Location (height)	Description	Start Data Collection	Source Initiation	Source Transition	Source Termination	Data Collection Stopped	Event Type
VS5_019	2 nd Deck-7 & 9 (1.2 m)	Spray aerosol	9:03:00	9:09:30		9:10:28	9:48:00	Nuisance
	Ops-13 (1.2 m)	SCBA		9:09:00		9:11:30		Gas release
	2 nd Deck-9	Smoldering cable bundle		9:11:00		9:47:10		Smoldering
	3rd Deck-1	Torch cutting steel		9:08:00		9:12:20		Nuisance
VS5_020	2 nd Deck-9	Space heater	10:20:00	10:25:00		10:38:00	10:38:00	Nuisance
	3rd Deck-3 (1.2 m)	Flash photography		10:25:06		10:27:25		Nuisance
	2nd Deck-7	IPA spill fire		10:33:07		10:38:00		Flaming
	3 rd Deck-4 (OH)	Pipe rupture – open pipe OH, 120 psig		10:29:13		10:30:13		Pipe rupture
VS5_021	2nd Deck-8	AM/FM radio	12:03:00	12:08:00		12:16:00	12:22:00	Nuisance
	3rd Deck-4	Engine exhaust with dewatering pump		12:09:00		12:15:00		Nuisance
	2nd Deck (OH)	Sprinkler/mist system (250 psig (AM-4))		12:19:09		12:20:55		Suppression system
	Ops-11	Smoldering laundry		12:08:00		12:22:00		Smoldering
VS5_022	3rd Deck-3	Welding	13:03:00	13:08:00		13:13:38	13:440:30	Nuisance
	2nd Deck-9 & 7	Waving materials		13:08:00		13:10:10		Nuisance
	3rd Deck-4 (1.2 m)	Pipe rupture (10" gash, 120 psig)		13:15:06		13:16:25		Pipe rupture
	Pway-14	Smoldering cable bundle		13:08:00		13:40:30		Smoldering
VS5_023	2nd Deck-8	Welding	14:30:00	14:35:00		14:41:00	14:44:00	Nuisance
	3rd Deck-1	Toaster (normal toasting)		14:35:00		14:40:40		Nuisance
	2nd Deck-8 (1.2 m)	Gas release (N_2, 250 psig)		14:42:30		14:43:15		Gas release
	Ops-11	Crumpled newspaper against wallboard		14:35:00		14:37:15		Flaming

Table 14 — Test Matrix for VS5 Test Series (Continued)

Test ID	Location (height)	Description	Start Data Collection	Source Initiation	Source Transition	Source Termination	Data Collection Stopped	Event Type
VS5_024	Ops-11 (1.2 m)	Gas release (N_2,100 psig)	8:38:00	8:43:00		8:45:23	8:48:30	Gas release
	Pway-14	Spilling bolts		8:43:00		8:43:50		Nuisance
	Ops-12 (1.2 m)	Pipe rupture (10" gash OH, 120 psig)		8:46:08		8:47:56		Pipe rupture
	3rd Deck-4 (OH)	Pipe rupture (Sprinkler, 120 psig)		8:43:00		8:44:40		Pipe rupture
VS5_025	Ops-12 (OH)	Pipe rupture – open pipe OH, 120 psig	9:31:00	9:36:07		9:37:10	9:50:00	Pipe rupture
	3rd Deck-3	Shipping supplies		9:36:00		9:50:00		Flaming
	Ops-11 (1.2 m)	Gas release (N_2, 250 psig)		9:39:00		9:40:35		Gas release
	PVLS-19 (1.2 m)	Gas release (N_2, 250 psig)		9:36:00		9:38:00		Gas release
VS5_026	Ops-10	Torch cutting steel	10:38:00	10:43:00		10:48:00	10:58:00	Nuisance
	3rd Deck-2	Shielded IPA pan		10:43:00		10:49:55		Flaming
	Ops-13 (1.2 m)	Gas release (N_2, 250 psig)		10:49:00		10:50:34		Gas release
	Pway-14	Smoldering oily rags		10:43:00		10:58:00		Smoldering
VS5_027	Ops-12 (OH)	Pipe rupture (9 hole, 250 psig)	12:23:00	12:28:07		12:30:03	12:45:30	Pipe rupture
	Pway-14	Torch cutting steel		12:28:00		12:34:00		Nuisance
	Ops-13	Shielded IPA pan		12:33:06		12:44:34		Flaming
	ES-18 (on ES Sub-floor bracing)	Smoldering mattress and bedding		12:28:00		12:41:30		Smoldering

Table 14 — Test Matrix for VS5 Test Series (Continued)

Test ID	Location (height)	Description	Start Data Collection	Source Initiation	Source Transition	Source Termination	Data Collection Stopped	Event Type
VS5_028	2nd Deck-8 (1.2 m)	Gas release-small orifice (N_2, 250 psig)	13:30:00	13:36:00		13:37:50	13:54:30	Gas release
	Ops-13	Smoldering oily rags		13:35:00		13:49:07		Smoldering
	2nd Deck-9	2 Smoldering boxes with polystyrene pellets		13:39:00		13:50:40		Smoldering
	PVLS	Smoldering oily rags		13:35:00		13:53:00		Smoldering
VS5_029	ES-17	Wall board above 6 in. dia IPA pan fire	8:36:00	8:41:03		8:49:50	9:03:00	Flaming
	3rd Deck-4 (1.2 m)	Pipe rupture (2" gash, 120 psig)		8:51:15		8:52:20		Pipe rupture
	Pway-20 (aft of FR 22)	Smoldering cable bundle		8:41:00		9:03:00		Smoldering
	2nd Deck-8	Smoldering cable bundle		8:43:23		9:03:00		Smoldering
VS5_030	2nd Deck-9 (1.2 m)	SCBA	10:00:00	10:06:00		10:07:10	10:22:30	Gas release
	ES-17 (on sub-floor frame)	Smoldering cable bundle		10:05:00		10:22:30		Smoldering
	2nd Deck-7	2 Flaming boxes with polystyrene pellets		10:08:00		10:13:30		Flaming
	Ops-11	Flaming shipping supplies		10:05:00		10:21:40		Flaming
VS5_031	3rd Deck-3 (1.2 m)	Gas release (air constant)	11:03:00	11:09:00		11:10:45	11:29:00	Gas release
	3rd Deck-5	Smoldering mattress and bedding		11:08:00		11:29:00		Smoldering
	Pvls-19	Arc welding		11:08:00		11:15:20		Nuisance
VS5_032	2nd Deck-9	8 Flaming cardboard boxes with polystyrene pellets	12:35:00	12:40:00		12:47:17	12:58:00	Flaming
	Pway-20 (Aft Of FR22)	Smoldering oily rags		12:40:00	12:54:23	12:57:48		Smoldering
	Ops-13	Waving materials		12:41:30		12:43:47		Nuisance

Table 14 — Test Matrix for VS5 Test Series (Continued)

Test ID	Location (height)	Description	Start Data Collection	Source Initiation	Source Transition	Source Termination	Data Collection Stopped	Event Type
VS5_033	Pway-14 (1.2 m)	Gas release (air constant)	14:25:00	14:30:20		14:33:10	14:50:30	Gas release
	3rd Deck-6	Painted bulkhead		14:31:00		14:40:35		Smoldering
	Pway-20	Flaming shipping supplies		14:33:30		14:50:30		Flaming
	2nd Deck-9	4 Flaming cardboard boxes with polystyrene pellets		14:30:20		14:33:52		Flaming
	2nd Deck-8 (OH)	Sprinkler/mist system, 250 psig (AM-11)		14:33:52		14:35:47		Suppression system
VS5_034	ES	People working	8:16:00	8:21:00		9:05:00	9:05:00	Nuisance
	2nd Deck	People working		8:21:00		9:05:00		Nuisance
	3rd Deck	People working		8:21:00		9:05:00		Nuisance
	Ops	People working		8:21:00		9:05:00		Nuisance
	PWAY	People working		8:21:00		9:05:00		Nuisance
VS5_035	Ops-22	181 kW Heptane fire	9:29:00	9:37:00		9:41:55	10:20:00	Flaming
	2nd Deck-9	43 kW Heptane fire		9:39:00		9:44:50		Flaming
	3rd Deck-1	Space heater		9:34:00		10:20:00		Nuisance
	3rd Deck-21 (OH)	Smoldering oily rags		9:35:00		10:20:00		Smoldering
VS5_036	Ops-22	43 kW Heptane fire	11:03:00	11:10:02		11:14:30	11:17:30	Flaming
	2nd Deck-9	181 kW Heptane fire		11:11:33		11:16:03		Flaming
	PVLS-15	Welding		11:08:00		11:13:50		Nuisance
	3rd Deck-1	2 Flaming cardboard boxes with polystyrene pellets		11:08:12		11:14:55		Flaming
VS5_037	Ops-22	132 kW Heptane fire	12:31:00	12:38:00		12:42:11	12:48:00	Flaming
	2nd Deck-9	13 kW Heptane fire		12:40:00		12:49:20		Flaming
	PVLS-15	Torch cutting		12:36:00		12:40:09		Nuisance
	3rd Deck-4	2 Flaming cardboard boxes with polystyrene pellets		12:36:13		12:48:13		Flaming

Table 14 — Test Matrix for VS5 Test Series (Continued)

Test ID	Location (height)	Description	Start Data Collection	Source Initiation	Source Transition	Source Termination	Data Collection Stopped	Event Type
VS5_038	Ops-22	13 kW Heptane fire	13:25:00	13:30:00		13:35:11	13:39:00	Flaming
	2nd Deck-9	132 kW Heptane fire		13:32:00		13:35:50		Flaming
	PVLS-19	Grinding painted steel		13:35:25		13:38:30		Nuisance
	3rd Deck-4 (1.2 m)	Pipe rupture (9 hole, 250 psig)		13:32:35		13:34:50		Pipe rupture
VS5_039	3rd Deck-6	Painted bulkhead with box targets	14:17:00	14:26:00		14:33:22	14:36:00	Smolder/flaming
	Pway-14	Grinding painted steel		14:26:30		14:30:00		Nuisance
	Ops-23 (1.2 m)	Radio		14:22:00		14:36:00		Nuisance
	Ops-11	Flaming trash can		14:30:45		14:39:08		Flaming

6.0 RESULTS

Table 15 lists the first alarm times for the two VSP systems, the two commercial VID systems, and the three spot type detector technologies (ion, photo, and multi-criteria). Appendix B and C contain the same data listed by Source type and Compartment respectively. Appendix D (see attached CD) contains Excel sheets with Tables containing alarm times from each of the VID system history files, from the Masscomp DAQ (spot-type detectors), as well as those produced by the sensor suite object log files and data fusion object log files (VSP alarms). The VSP alarm times in Table 15 are taken from the alarm tables produced by the data fusion object log files. The VID alarm time are taken directly from the VID system history log files, while the spot-type detector alarm times are taken from the Masscomp DAQ files. The detection system alarm times are recorded for each test and source as seconds after initiation of the source. The alarm times in Table 15 are "first alarm times". Thus, when a false positive alarm occurs it is counted as a nuisance alarm in Table 15, no attempt is made to determine whether or not the system correctly identified the source at a later time. The test number, location (including compartment and source location), as well as brief source descriptions, are listed in columns 1 though 3. VSP1 and VSP2 alarm times and alarm types are listed in columns 4 though 7. The VSP systems have five alarm types: flame (F), smoke (S), gas release (G), water release (W), or suppression activation (SU). If the system did not alarm for a particular source, then a DNA is listed. Following the VSP system results are the VID system results in columns 8 though 11. The time to alarm for the VID systems is followed by the alarm type or combination of alarm types (if more than one alarm activated at the same time). The SFA VID system alarm types include smoke (S) and flame (F). The SigniFire VID system alarm types include smoke (S), flame (F), and offsite (O). If the VID system did not alarm, a DNA was recorded. The abbreviations used in Table 15 hold true for the tables in Appendix B and C. The EST spot type detector alarm times are listed in the remaining three columns, 12 through 14. A notation of NA means the system was not available (either due to wiring problems, absence of the system in a compartment (no Spot-type detectors were located in the PVLS) or the loss of the Masscomp data acquisition system). Negative alarm times are shown for cases in which the system alarmed prior to the start of the source; these are false positives and are counted as nuisance alarms. No attempt was made to determine whether or not a system correctly classified a source subsequent to generating a false positive. It should also be noted that many of the cells contain an "x." The x mark indicates a situation where a system alarmed for a previous source conducted in the same space as the source with the x. This notation is used for the cases where the first source caused a latching alarm condition that prevented the system from properly recognizing the second source.

VS5 is the first test series to include nuisance blocking of flame and smoke alarms for fire-like nuisance sources, namely welding and grinding. As a consequence of this new feature, and because SigniFire alarms latch, the DFAM software was modified to send a "reset" message to Signifire (ClearAlarm message to SFA) when nuisance blocking was turned off. Thus, if a welding/grinding source caused a flame or smoke alarm on the VID system, it would be cleared and the system reset at the same time that nuisance blocking was turned off. The flame and smoke detection capabilities were then restored to that data fusion object (aka compartment).

Table 15 — VS5 Test Series Alarm Times in Seconds after Source Initiation

Test ID	Location	Description	VSP1	Alarm Type	VSP2	Alarm Type	SFA	Alarm Type	Signi-Fire	Alarm Type	EST ION	EST PHOTO	EST MULTI
VS5_001	3rd Deck-3	4 Flaming cardboard boxes with PS	100	F	101	F	210	S	54	O	NA	NA	NA
	2nd Deck-7	Torch cutting steel	63	S	87	S	53	S	70	S	NA	NA	NA
VS5_002	2nd Deck-7	Flaming trash can	319	S	291	S	309	S	231	O	93	328	173
	Ops-11	Welding	DNA	DNA	DNA	DNA	76	F	34	O	DNA	DNA	DNA
	2nd Deck-8	Gas release (air bursts)	DNA	DNA	DNA	DNA	x	x	x	x	x	x	x
VS5_003	Ops-13	Heat gun	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	2nd Deck-8	Gas release (N_2, 100 psig)	2	G	1	G	DNA	DNA	9	F	DNA	DNA	DNA
	Ops-12	Water aerosol (mist,60 psig)	167	SU	181	SU	DNA	DNA	DNA	DNA	DNA	DNA	DNA
VS5_004	Ops-11	2 Flaming cardboard boxes with polystyrene pellets	163	S	231	S	157	S	221	SO	0	18	18

Table 15 — VS5 Test Series Alarm Times in Seconds after Source Initiation (Continued)

Test ID	Location	Description	VSP1	Alarm Type	VSP2	Alarm Type	SFA	Alarm Type	Signi-Fire	Alarm Type	EST ION	EST PHOTO	EST MULTI
	3rd Deck-5	2 Flaming boxes with polystyrene pellets	173	S	434	S	167	S	432	SO	-25	175	120
	Ops-13	Pipe rupture (gash, 40 psig)	67	W	68	W	x	x	x	x	x	x	x
VS5_005	2nd Deck-7	Smoldering oily rags	379	S	370	S	-33	F	360	S	883	558	583
	3rd Deck-4	Pipe rupture (gash, 60 psig)	27	W	29	W	DNA	DNA	4716	F	DNA	DNA	DNA
	Ops-13	Pipe rupture (mist, 60 psig)	226	SU	226	SU	DNA	DNA	DNA	DNA	DNA	DNA	DNA
VS5_006	Ops-12	Smoldering Laundry	253	S	459	S	246	S	450	S	805	760	765
	3rd Deck	People working in space	DNA	DNA	DNA	DNA	58	F	58	F	DNA	DNA	DNA
	Ops-13	Pipe rupture (sprinkler, 60)	49	W	48	W	x	x	x	x	x	x	x
VS5_007	3rd Deck-4 on deck	Smoldering cable bundle	DNA	DNA	DNA	DNA	DNA	DNA	1576	O	1525	1900	1915
	Pway-16	IPA spill fire	DNA	DNA	612	F	DNA	DNA	603	F	383	703	563
	3rd Deck-5	Gas leak	1225	W	25	W	DNA	DNA	x	x	x	x	x

Table 15 — VS5 Test Series Alarm Times in Seconds after Source Initiation (Continued)

Test ID	Location	Description	VSP1	Alarm Type	VSP2	Alarm Type	SFA	Alarm Type	Signi-Fire	Alarm Type	EST ION	EST PHOTO	EST MULTI
VS5_008	Ops-13	Flaming shipping supplies	92	F	93	F	195	S	285	FO	370	435	445
	3rd Deck-3	Flaming trash can	112	F	120	F	278	S	103	O	345	750	420
	Ops-11	Gas Release (N_2, 100 psig)	DNA	DNA	DNA	DNA	x	x	x	x	x	x	x
VS5_009	3rd Deck-2	IPA spill fire	17	F	18	F	107	S	9	O	335	635	415
	Ops-23	Toaster (normal toasting)	396	S	DNA	DNA	386	S	430	S	442	637	617
	3rd Deck-5	SCBA	DNA	DNA	DNA	DNA	x	x	x	x	x	x	x
VS5_010	Ops-23	TV	DNA	DNA	DNA	DNA	595	F	DNA	DNA	DNA	DNA	DNA
	Ops-12	Smoldering cable bundle	900	S	388	S	x	x	376	S	DNA	1500	DNA
	3rd Deck-5	Gas release (N_2, 100 psig)	37	G	37	G	DNA	DNA	-1701	O	DNA	DNA	DNA
VS5_011	3rd Deck-5	Torch cutting steel	158	F	161	F	174	S	200	S	323	DNA	423
	Ops-13	Pipe Rupture (open pipe, 120 psig)	70	SU	70	SU	DNA	DNA	DNA	DNA	DNA	DNA	DNA
VS5_012	2nd Deck-8	Grinding painted steel	DNA	DNA	DNA	DNA	70	S	DNA	DNA	DNA	DNA	DNA
	Ops-10	Smoldering oily rags	214	S	260	S	220	S	250	S	DNA	605	DNA

Table 15 — VS5 Test Series Alarm Times in Seconds after Source Initiation (Continued)

Test ID	Location	Description	VSP1	Alarm Type	VSP2	Alarm Type	SFA	Alarm Type	Signi-Fire	Alarm Type	EST ION	EST PHOTO	EST MULTI
	2nd Deck-7	2 Flaming cardboard boxes with polystyrene pellets	222	S	221	S	x	x	73	O	325	345	340
VS5_013	Ops-13	Welding	487	S	485	S	124	S	DNA	DNA	440	365	450
	2nd Deck-7	Smoldering laundry	246	S	256	S	236	S	247	S	770	635	675
	Ops-13	IPA spill fire	15	F	15	F	x	x	16	O	x	x	x
VS5_014	3rd Deck-1	Space heater	37[1]	S[1]	37[1]	S[1]	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	Pway-14	Gas release (air)	DNA	DNA	DNA	DNA	DNA	DNA	635	F	DNA	DNA	DNA
	3rd Deck-1	Smoldering laundry	DNA	DNA	DNA	DNA	181	F	567	S	905	790	825
VS5_015	Ops-13	Grinding painted steel	DNA	DNA	DNA	DNA	77	S	288	S	DNA	DNA	DNA
	2nd Deck-8	Flaming shipping supplies	296	F	265	S	162	S	202	S	415	DNA	935
	ES-17	Flaming trash can	126	S	139	S	116	S	130	S	345	550	425
	Ops-13	Smoldering cable bundle	305	S	353	S	x	x	x	x	1090	895	845
VS5_016	2nd Deck-7 on cabinet	Toaster (normal toasting)	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	ES-18	Smoldering cable bundle	211	S	278	S	202	S	267	S	DNA	625	715

1 Alarm was caused by power issue.

Table 15 — VS5 Test Series Alarm Times in Seconds after Source Initiation (Continued)

Test ID	Location	Description	VSP1	Alarm Type	VSP2	Alarm Type	SFA	Alarm Type	Signi-Fire	Alarm Type	EST ION	EST PHOTO	EST MULTI
	PVLS Deck-15	4 Flaming cardboard boxes with PS	249	F	249	F	DNA	DNA	272	FO	NA	NA	NA
	2nd Deck-8	Smoldering mattress and bedding	190	S	259	S	181	S	233	S	202	327	302
VS5_017	3rd Deck-3	AM/FM radio	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	Pway-14	Flaming trash can	DNA	DNA	63	F	108	F	16	F	360	DNA	415
	Ops-13	Smoldering mattress	223	S	413	S	215	S	404	S	590	565	535
	3rd Deck-5	Smoldering oily rags	416	S	976	S	408	S	1141	S	1240	1087	960
VS5_018	Ops-11	Welding	DNA	DNA	DNA	DNA	94	S	58	O	DNA	DNA	DNA
	3rd Deck-1	Shipping supplies	163	F	162	F	602	S	204	F	435	DNA	DNA
	Pway-14	People in space	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	Ops-13	Flaming trash can	96	F	93	F	x	x	x	x	35	130	75
VS5_019	2nd Deck-7 & 9	Spray aerosol	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	Ops-13	SCBA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA

Table 15 — VS5 Test Series Alarm Times in Seconds after Source Initiation (Continued)

Test ID	Location	Description	VSP1	Alarm Type	VSP2	Alarm Type	SFA	Alarm Type	Signi-Fire	Alarm Type	EST ION	EST PHOTO	EST MULTI
	2nd Deck-9	Smoldering cable bundle	DNA	DNA	820	S	DNA	DNA	811	S	DNA	1475	2260
	3rd Deck-1	Torch cutting steel	DNA	DNA	DNA	DNA	137	S	212	F	345	DNA	505
VS5_020	2nd Deck-9	Space heater	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	3rd Deck-3	Flash photography	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	2nd Deck-7	IPA spill fire	16	F	19	F	119	F	28	O	328	533	368
	3rd Deck-4	Pipe rupture (open pipe OH, 120 psig)	23	W	23	W	29	S	DNA	DNA	DNA	DNA	DNA
VS5_021	2nd Deck-8	AM/FM radio	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	3rd Deck-4	Engine exhaust with dewatering pump	374	S	DNA	DNA	370	S	1693	F	375	DNA	DNA
	2nd Deck	Sprinkler/mist system (250 psig (AM-4))	23	S	27	W	18	S	DNA	DNA	DNA	336	DNA
	Ops-11	Smoldering laundry	208	S	199	S	203	S	189	S	1005	850	DNA
VS5_022	3rd Deck-3	Welding	DNA	DNA	DNA	DNA	91	S	57	F	355	360	365

Table 15 — VS5 Test Series Alarm Times in Seconds after Source Initiation (Continued)

Test ID	Location	Description	VSP1	Alarm Type	VSP2	Alarm Type	SFA	Alarm Type	Signi-Fire	Alarm Type	EST ION	EST PHOTO	EST MULTI
	2nd Deck-9 & 7	Waving materials	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	3rd Deck-4	Pipe rupture (10" gash, 120 psig)	22	W	29	W	x	x	x	x	x	x	x
	Pway-14	Smoldering cable bundle	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
VS5_023	2nd Deck-8	Welding	DNA	DNA	DNA	DNA	8	F	DNA	DNA	450	DNA	DNA
	3rd Deck-1	Toaster (normal toasting)	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	580	DNA	DNA
	2nd Deck-8	Gas release (N_2, 250 psig)	34	G	35	G	x	x	DNA	DNA	x	DNA	DNA
	Ops-11	Crumpled newspaper against wallboard	36	F	36	F	61	S	116	S	345	400	380
VS5_024	Ops-11	Gas release (N_2 100 psig)	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA

Table 15 — VS5 Test Series Alarm Times in Seconds after Source Initiation (Continued)

Test ID	Location	Description	VSP1	Alarm Type	VSP2	Alarm Type	SFA	Alarm Type	Signi-Fire	Alarm Type	EST ION	EST PHOTO	EST MULTI
	Pway-14	Spilling bolts	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	Ops-12	Pipe rupture (10" Gash OH, 120 psig)	21	W	20	W	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	3rd Deck-4	Pipe rupture (sprinkler, 120 psig)	31	S	81	W	19	S	-299	F	DNA	DNA	DNA
VS5_025	Ops-12	Pipe Rupture (open pipe OH, 120 psig)	21	W	21	W	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	3rd Deck-3	Shipping supplies	301	F	301	F	400	S	134	O	385	DNA	640
	Ops-11	Gas release (N_2, 250 psig)	78	G	79	G	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	PVLS-19	Gas release (N_2, 250 psig)	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	NA	NA	NA
VS5_026	Ops-10	Torch cutting steel	90	S	224	S	89	S	223	S	DNA	DNA	DNA
	3rd Deck-2	Shielded IPA pan	181	F	185	F	DNA	DNA	1017	F	495	DNA	DNA

Table 15 — VS5 Test Series Alarm Times in Seconds after Source Initiation (Continued)

Test ID	Location	Description	VSP1	Alarm Type	VSP2	Alarm Type	SFA	Alarm Type	Signi-Fire	Alarm Type	EST ION	EST PHOTO	EST MULTI
	Ops-13	Gas release (N_2, 250 psig)	73	G	74	G	x	x	x	x	30	DNA	70
	Pway-14	Smoldering oily rags	DNA	DNA	DNA	DNA	DNA	DNA	1493	F	DNA	735	875
VS5_027	Ops-12	Pipe rupture (9 hole, 250 psig)	93	S	99	W	93	S	DNA	DNA	DNA	DNA	DNA
	Pway-14	Torch cutting steel	DNA	DNA	DNA	DNA	67	F	71	F	365	DNA	430
	Ops-13	Shielded IPA pan	101	F	99	F	x	x	DNA	DNA	459	DNA	579
	ES-18	Smoldering mattress and bedding	314	S	356	S	307	S	347	S	DNA	720	925
VS5_028	2nd Deck-8	Gas release small orifice (N_2, 250 psig)	93	G	92	G	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	Ops-13	Smoldering oily rags	247	S	252	S	246	S	243	S	1065	755	880
	2nd Deck-9	2 Smoldering boxes with polystyrene pellets	317	S	394	S	317	S	386	S	875	705	655
	PVLS	Smoldering oily rags	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	NA	NA	NA

Table 15 — VS5 Test Series Alarm Times in Seconds after Source Initiation (Continued)

Test ID	Location	Description	VSP1	Alarm Type	VSP2	Alarm Type	SFA	Alarm Type	Signi-Fire	Alarm Type	EST ION	EST PHOTO	EST MULTI
VS5_029	ES-17	Wall board above 6 in. dia IPA pan fire	92	S	100	S	82	S	92	SO	377	362	392
	3rd Deck-4	Pipe rupture (2" gash, 120 psig)	26	W	40	W	-373	S	-280	S	140	130	65
	Pway-20 (aft of FR 22)	Smoldering cable bundle	DNA	DNA	DNA	DNA	DNA	DNA	375	F	DNA	DNA	DNA
	2nd Deck-8	Smoldering cable bundle	431	S	727	S	421	S	718	S	DNA	1077	DNA
VS5_030	2nd Deck-9	SCBA	34	G	33	G	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	ES-17	Smoldering cable bundle	268	S	573	S	253	S	DNA	DNA	DNA	765	930
	2nd Deck-7	2 Flaming boxes with polystyrene pellets	152	S	181	S	153	S	171	SO	355	400	400
	Ops-11	Flaming shipping supplies	182	S	258	S	194	S	496	S	430	510	510
VS5_031	3rd Deck-3	Gas release-(air constant)	64	G	63	G	x	x	x	x	x	x	x
	3rd Deck-5	Smoldering mattress and bedding	246	S	694	S	246	S	685	S	665	775	670

Table 15 — VS5 Test Series Alarm Times in Seconds after Source Initiation (Continued)

Test ID	Location	Description	VSP1	Alarm Type	VSP2	Alarm Type	SFA	Alarm Type	Signi-Fire	Alarm Type	EST ION	EST PHOTO	EST MULTI
	PVLS-19	Arc welding	153	S	151	S	DNA	DNA	DNA	DNA	NA	NA	NA
VS5_032	2nd Deck-9	8 Flaming cardboard boxes with polystyrene pellets	154	S	177	S	154	F	155	SFO	430	465	460
	Pway-20 (aft of FR22)	Smoldering oily rags	1038	F	1026	F	DNA	DNA	901	F	1210	1080	1085
	Ops-13	Waving materials	191	S	DNA	DNA	156	F	1083	S	DNA	DNA	DNA
VS5_033	Pway-14	Gas release (air constant)	59	S	115	G	60	S	DNA	DNA	DNA	DNA	DNA
	3rd Deck-6	Painted bulkhead	185	S	179	S	187	S	169	S	415	430	435
	Pway-20	Flaming shipping supplies	123	F	121	F	x	x	78	F	DNA	DNA	DNA
	2nd Deck-9	4 Flaming cardboard boxes with polystyrene pellets	139	F	139	F	141	S	82	FO	DNA	DNA	DNA
	2nd Deck-8	Sprinkler/mist system (250 psig (AM-11))	114	G	114	G	x	x	x	x	183	273	223

Table 15 — VS5 Test Series Alarm Times in Seconds After Source Initiation (Continued)

Test ID	Location	Description	VSP1	Alarm Type	VSP2	Alarm Type	SFA	Alarm Type	Signi-Fire	Alarm Type	EST ION	EST PHOTO	EST MULTI
VS5_034	ES	People working	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	2nd Deck	People working	DNA	DNA	DNA	DNA	873	F	DNA	DNA	DNA	DNA	DNA
	3rd Deck	People working	DNA	DNA	DNA	DNA	1780	F	DNA	DNA	DNA	DNA	DNA
	Ops	People working	DNA	DNA	DNA	DNA	467	F	DNA	DNA	DNA	DNA	DNA
	PWAY	People working	DNA	DNA	DNA	DNA	DNA	DNA	-227	F	DNA	DNA	DNA
VS5_035	Ops-22	181 kW Heptane fire	23	F	19	F	48	S	44	S	325	330	340
	2nd Deck-9	43 kW Heptane fire	18	F	18	F	75	F	166	O	345	385	370
	3rd Deck-1	Space heater	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	3rd Deck-21	Smoldering oily rags	DNA	DNA	1573	S	DNA	DNA	1563	S	1795	2035	2410
VS5_036	Ops-22	43 kW Heptane fire	17	F	18	F	79	S	180	S	338	423	388
	2nd Deck-9	181 kW Heptane fire	18	F	18	F	48	S	DNA	DNA	327	337	342
	PVLS-15	Welding	DNA	DNA	DNA	DNA	DNA	DNA	35	S	NA	NA	NA
	3rd Deck-1	2 Flaming cardboard boxes with polystyrene pellets	156	F	153	F	162	S	79	F	373	443	483

Table 15 — VS5 Test Series Alarm Times in Seconds after Source Initiation (Continued)

Test ID	Location	Description	VSP1	Alarm Type	VSP2	Alarm Type	SFA	Alarm Type	Signi-Fire	Alarm Type	EST ION	EST PHOTO	EST MULTI
VS5_037	Ops-21	132 kW Heptane Fire	19	F	18	F	51	S	61	S	NA	NA	NA
	2nd Deck-9	13 kW Heptane fire	20	F	19	F	84	F	16	O	NA	NA	NA
	PVLS-15	Torch cutting	DNA	DNA	177	F	DNA	DNA	DNA	DNA	NA	NA	NA
	3rd Deck-4	2 Flaming cardboard boxes with polystyrene pellets	255	S	379	S	258	S	369	S	NA	NA	NA
VS5_038	Ops-21	13 kW Heptane fire	25	F	24	F	110	S	598	S	345	495	450
	2nd Deck-9	132 kW Heptane fire	18	F	17	F	45	S	110	O	330	335	340
	PVLS-19	Grinding painted steel	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	NA	NA	NA
	3rd Deck-4	Pipe rupture (9 hole, 250 psig)	35	S	DNA	DNA	37	S	DNA	DNA	DNA	DNA	DNA

Table 15 — VS5 Test Series Alarm Times in Seconds after Source Initiation (Continued)

Test ID	Location	Description	VSP1	Alarm Type	VSP2	Alarm Type	SFA	Alarm Type	Signi-Fire	Alarm Type	EST ION	EST PHOTO	EST MULTI
VS5_039	3rd Deck-6	Painted bulkhead with box targets	325	S	DNA	DNA	329	S	346	SO	470	560	550
	Pway-14	Grinding painted steel	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	Ops-23	Radio	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	Ops-11	Flaming trash can	123	S	DNA	DNA	131	S	149	S	155	415	405

7.0 DISCUSSION

The following measures of performance were used to evaluate and compare the different detection technologies:

1. Percent correct classification.
2. Speed of response.

7.1 Source Classification

Table 16 lists the percent correct classification of each system by source type. The percent correct classification represents the number of sources the system correctly classified. Although specific event types of flaming and smoldering fires are identified in the Table, these delineations are for identifying detection system performance variations for these types of fires; they do not represent the type of alarm classification from the systems. For example, the first entry shows that 95% of the flaming sources were correctly classified as a fire by VSP1. This number does not mean that VSP1 correctly classified all flaming fires as flaming events. The alarms can be from either a smoke alarm algorithm or a flame alarm algorithm. Though the Volume Sensor system and the VID systems can identify flaming fires specifically, they are unable to determine if a smoke alarm is actually from a smoldering fire or from an obstructed flaming fire. The third event type in Table 16, Fire Sources, represents the combination of results for the smoldering and flaming fires together.

Table 16 — Summary of Events Positively Detected by the VSPs and the Commercial Fire Detection Systems

Event Type	VSP1	VSP2	SFA	SigniFire	Ionization	Photoelectric	Multi-criteria
Flaming[1]	95% (38)	97% (38)	91% (33)	95% (37)	88% (32)	75% (32)	88% (32)
Smoldering[2]	71% (28)	75% (28)	65% (26)	89% (27)	63% (27)	93% (27)	78% (27)
Fire Sources	85% (66)	88% (66)	80% (59)	92% (64)	76% (59)	83% (59)	83% (59)
Nuisance	80% (40)	85% (40)	49% (43)	57% (45)	71% (38)	92% (32)	83% (36)
Pipe Rupture[3]	88% (16)	88% (16)	NA[4]	NA	NA	NA	NA
Gas Release	53% (17)	53% (17)	NA	NA	NA	NA	NA

NA Not Applicable
1 Percent of flaming sources detected as a fire
2 Percent of smoldering sources detected as a fire
3 Percent of water release and suppression activation sources detected
4 The SFA system produced 4 smoke alarms to the 16 pipe rupture event.

It should be noted that when calculating the percent of correctly classified nuisance sources, the value is equal to the number of times a given system did not alarm to a nuisance source divided by the number of nuisance sources tested and the number of false positives. The percent correct classification of pipe rupture events include the number of Water (W) or Suppression (SU) alarms that the VSP systems produced when exposed to any event with water flow. Although not reported in Table 16, the SFA system smoke algorithms (and subsequently the VSP2 smoke alarm) detected four of the 16 pipe rupture events prior to the VSP systems

indicating Water or Suppression alarms. These results indicate the potential of the VID systems to detect rupture events that produce water spray or mist within the field of view of the camera. Because the smoke alarm was not considered a false positive and counted as a nuisance alarm the second alarm recorded after the smoke alarm was used in calculating the percent correct classification.

The number of tests used to calculate the percent correct classification for each detection system and event type is shown in parentheses. The number of tests used to calculate the percent correct classification values varies for the different detection systems due to the tests where multiple source initiations in a single compartment caused an alarm condition that prevented the system from properly recognizing the second source. These circumstances are discussed in Section 6 and marked with an "x" in Table 15. As can be seen in Table 16, the VSP systems are evaluated on the maximum number of event exposures, where as the other detection systems are evaluated on a fewer number of events due to latching alarms that cause the inability to distinguish between multiple events in a space.

Overall, VSP1 and VSP2 provided 85 and 88% detection capability for all fire sources and 78 and 83% correct detection of nuisance sources, respectively. The majority of fires that were not detected consisted of smoldering fires. In particular, 4 smoldering cable fires located in the passageway (2), 2nd Deck Magazine (1), and 3rd Deck Magazine (1) were not detected by VSP1. VSP2 missed all but the smoldering cable fire in the 2nd deck magazine. Three smoldering oily rag fires located in the PVLS (1), passageway (1), and 3rd Deck Magazine (1); and one Smoldering Laundry in the 3rd Deck Magazine (1) were missed by VSP1 and VSP2. The sources in the passageway were most likely not detected because of the very low light levels and because the high ventilation rate rapidly diluted the smoke. The inability to detect the smoldering oily rags within the PVLS is not known at this time. VSP1 did not detect 2 flaming fires and VSP2 did not detect 1 flaming fire. VSP1 did not detect an IPA spill fire and a flaming trash can fire in the passageway. VSP2 did not detect a trash can fire in the operations office. The trash can fires were difficult to detect because of the shielded nature, small fire size, and light smoke.

The VSP systems correctly classified 15 of 16 ruptures. The only rupture missed was the pipe with nine holes supplied with water at 250 psig. It is not known at this time why that event was not classified correctly. The VSP systems had difficulty detecting and correctly classifying gas releases as indicated by the 53% success rate. It is not known at this time why 47% of the gas leaks were not detected or detected but misclassified (one test was classified as a water rupture).

To date, this test series provided the most successful recording of a hot bulkhead adjacent space fire. Work is ongoing to establish alarm criteria and thresholds for the hot object alarm.

7.2 Time to Alarm

Table 17 lists the percentage of alarms for a given detection system that activated first, within 30 seconds of the first alarm, and within 120 seconds of the first alarm. The Table compares the two VSP systems to the commercial spot-type smoke detection systems and is organized by

source type. Using VSP1 and flaming fires as an example, the Table shows that for 82% of the flaming fire sources, VSP1 activated first or tied for first. 120 seconds after the first alarm, the VSP1 system had alarmed in 88% of the tests. For these flaming fires, the ionization detectors alarmed first 12% of the time, and within 120 seconds of the first alarm they had activated in 21% of the cases.

Table 17: Percent of tests the VSP and commercial spot-type detector systems were the first, within 30 seconds or within 120 seconds of the first alarm for flaming and smoldering sources.

Flaming (33 events)					Flaming (33 events)				
	VSP1	**EST Ion**	**EST Photo**	**EST Multi**		**VSP2**	**EST Ion**	**EST Photo**	**EST Multi**
First	82%	12%	3%	6%	First	82%	12%	3%	6%
30 sec	82%	12%	3%	6%	30 sec	82%	12%	3%	6%
120 sec	88%	21%	9%	15%	120 sec	85%	18%	9%	12%
Smoldering (27 events)					**Smoldering (27 events)**				
	VSP1	**EST Ion**	**EST Photo**	**EST Multi**		**VSP2**	**EST Ion**	**EST Photo**	**EST Multi**
First	74%	7%	11%	0%	First	67%	14%	4%	4%
30 sec	74%	7%	11%	0%	30 sec	74%	14%	4%	7%
120 sec	74%	11%	14%	4%	120 sec	78%	18%	18%	18%

The percentages, in Table 17, are calculated using all events in which both the VSP and spot detection systems were operational (i.e., 33 flaming fires and 27 smoldering fires). Five flaming fires and 1 smoldering fire are not included due to data acquisition problems that prevented the smoke detector alarm times from being recorded. Unlike the calculation of percent correct classification in Table 16, where some of the secondary source events in a space were omitted, all events are included in this analysis. Therefore, these results account for events in which the spot smoke detectors did not respond to secondary sources within compartments. The alarm response percentages in Table 17 include events where the systems did not alarm. The sum of the percentages of systems first responding exceed 100% for the flaming fires due to two systems simultaneously alarming first to the same fire. For the smoldering fires, the sum is less than 100% because there were 3 events in which no system alarmed. These events included two smoldering cable bundles and one smoldering oily rags fire. The two cable bundles were located in the passageway where low lighting and a high ventilation rate resulted in no spot-type or VSP alarms.

The response time-based performance results for the two VSP systems are compared in Table 18 using the same analysis as presented in Table 17. Table 18 lists the percentage of alarms for a given detection system that activated first, within 30 seconds of the first alarm, and within 120 seconds of the first alarm.

Table 18 — Response Time Comparison of the Two Prototype Volume Sensor Systems

Flaming (38 events)		
	VSP1	VSP2
First	61%	58%
30 sec	93%	87%
120 Sec	96%	93%
Smoldering (28 events)		
	VSP1	VSP2
First	54%	25%
30 sec	68%	32%
120 Sec	68%	53%

8.0 PERFORMANCE SUMMARY

The VSP systems demonstrated the ability to operate in multiple compartments, discriminate sources in those varying compartments, and discriminate multiple events occurring consecutively within a compartment or simultaneously in multiple compartments. The ability of the VSPs to function in multiple compartments and correctly classify multiple events is supported by the results presented in Table 15 and the ability of the VSPs to correctly classify a large number of sources, Table 16. During this test series it was also demonstrated that the AFSS control system and the VSP systems were successfully integrated. The control system reported specific alarm types and displayed them along with automatic video feeds of the effected spaces. The viability of the Volume Sensor approach in a node-room architecture was also successfully demonstrated.

The performance of the two VSP systems was generally comparable for their ability to detect events, but the speed of response of the systems varied considerably. As can be seen in Table 16, VSP1 and VSP2 differed by only one flaming fire, one smoldering fire and two nuisance sources relative to the number of sources correctly detected. The comparison of the speed to alarm for the two systems is presented in Table 18. For flaming fires, the response of VSP1 and VSP2 were comparable. However, for smoldering fires, VSP1 was significantly faster than VSP2. VSP1 was first to detect in 54% of the smoldering fires and VSP2 detected the source first in only 25% of the events. As the results show, VSP2 was upwards of 1 to 2 minutes slower in many cases. The main difference in performance is attributed to the slower response of the SigniFire VID system used in VSP2 compared to the response of the SFA system used in VSP1. In summary, VSP1 was generally considered to perform better than VSP2. Consequently, the remainder of this discussion will focus on the results of VSP1.

The VSP systems provided better overall detection capabilities than the individual VID systems and the spot-type smoke detection systems. This conclusion is in part due to the

capability of the volume sensor system to detect water and gas releases and to block particular nuisance sources, such as welding. The commercial VID and spot-type fire detection systems are not designed for this broad range of casualty assessment. As shown in Table 16, the VSP system had comparable percent correct classification of fires as the VID and spot detectors; however, the actual number of fires detected was larger for the VSP system than the component VID system. For example, VSP1 alarmed to 56 fires (85% of 66 events) and SFA, the VID system used by VSP1, alarmed to 47 fires (80% of 59 events). Comparing the nuisance source results in Table 16 also shows that the VSP system was able to enhance the nuisance source immunity of the SFA VID system; VSP1 correctly classified 78% of the nuisance sources compared to only 51% correct classification by the VID system.

Besides the broad detection capability of the VSP system, the VSP responded much more quickly than the spot-type smoke detection systems. VSP1 detect 82% of the flaming fires first and 74% of the smoldering fires first before the spot smoke detectors. Even after 120 seconds of the first alarm, VSP1 had responded to most of the fires, where as less than 21% of the spot detectors had alarmed (Table 17). In other words, the majority of the spot-detectors alarmed more than two minutes after the VSP.

9.0 CONCLUSIONS

The Volume Sensor Test Series 5 successfully demonstrated the functionality and performance of two VSP systems. Based on the test series and this analysis, the following conclusions are presented:

- The VSP systems demonstrated the ability to function in multiple compartments, specifically discriminating between multiple types of events in multiple compartments.
- The VSP systems demonstrated the ability to discriminate between source types by detecting flaming and smoldering fire sources, water releases, and gas releases while rejecting nuisance sources.
- The VSP systems generally performed better than VID and spot-type smoke detection systems relative to range of detection capabilities, ability to detect fires, ability to reject nuisance sources, and speed of response.
- The ability of the AFSS control system to interface with the VSP was successfully demonstrated.
- The viability of the Volume Sensor approach in a node-room architecture was also successfully demonstrated.

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APPENDIX A

VIDEO IMAGES FROM EACH VSP LOCATION TAKEN FROM THE CCTV CAMERA COMPONENT

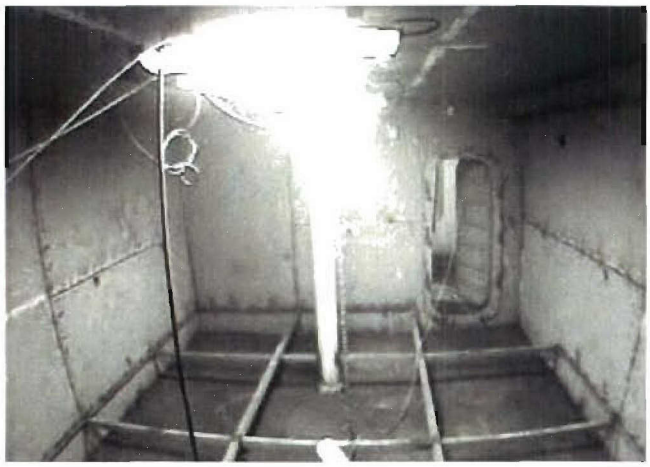

Fig. A-1 — Image looking starboard of Electronic Space taken from VSP1

Fig. A-2 — Image looking aft of 3rd Deck Magazine taken from VSP2

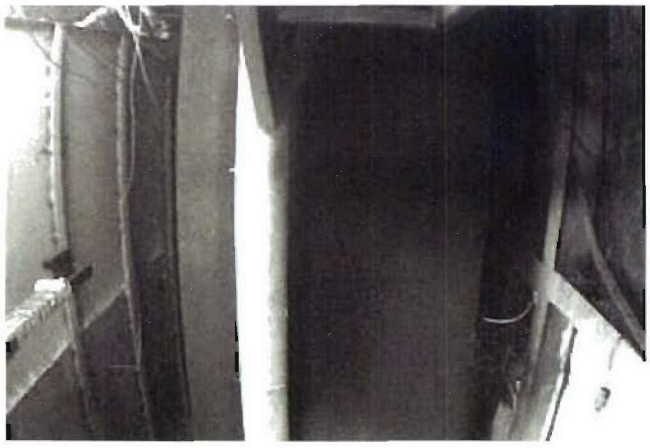

Fig. A-3 — Image looking port of 3rd Deck Magazine taken from VSP3

Fig. A-4 — Image looking forward of 2nd Deck Magazine taken from VSP4

Fig. A-5 — Image looking forward of Operations Office taken from VSP5

Fig. A-6 — Image looking forward of Operations Office taken from VSP6

Fig. A-7 — Image looking forward of 2nd Deck Starboard Passageway taken from VSP7

Fig. A-8 — Image looking down PVLS taken from VSP8

APPENDICES B, C & D

Volume Sensor Development Test Series 5
Multi-Compartment Systems

Test ID	Location	Description	Source type	Start Data Collection
VS5_037	2nd Deck-9	13 kW Heptane Fire	Flaming	12:31:00
VS5_038	Ops-21	13 kW Heptane Fire	Flaming	13:25:00
VS5_038	2nd Deck-9	132 kW Heptane Fire	Flaming	13:25:00
VS5_037	Ops-21	132 kW Heptane Fire	Flaming	12:31:00
VS5_036	2nd Deck-9	181 kW Heptane Fire	Flaming	11:03:00
VS5_035	Ops-22	181 kW Heptane Fire	Flaming	9:29:00
VS5_035	2nd Deck-9	43 kW Heptane Fire	Flaming	9:29:00
VS5_036	Ops-22	43 kW Heptane Fire	Flaming	11:03:00
VS5_030	2nd Deck-7	2 Flaming Boxes with Polystyrene Pellets	Flaming	10:00:00
VS5_004	3rd Deck-5	2 Flaming Boxes with Polystyrene Pellets	Flaming	9:22:00
VS5_036	3rd Deck-1	2 Flaming Cardboard Boxes with Polystyrene Pellets	Flaming	11:03:00
VS5_037	3rd Deck-4	2 Flaming Cardboard Boxes with Polystyrene Pellets	Flaming	12:31:00
VS5_004	Ops-11	2 Flaming Cardboard Boxes with Polystyrene Pellets	Flaming	9:22:00
VS5_033	2nd Deck-9	4 Flaming Cardboard Boxes with Polystyrene Pellets	Flaming	14:25:00
VS5_001	3rd Deck-3	4 Flaming Cardboard Boxes with PS	Flaming	11:12:00
VS5_016	PVLS Deck-15	4 Flaming Cardboard Boxes with PS	Flaming	12:12:00
VS5_032	2nd Deck-9	8 Flaming Cardboard Boxes with Polystyrene Pellets	Flaming	12:35:00
VS5_023	Ops-11	Crumpled newspaper against wallboard	Flaming	14:30:00
VS5_012	2nd Deck-7	Flaming Cardboard Boxes with Polystyrene Pellets	Flaming	14:27:00
VS5_015	2nd Deck-8	Flaming Shipping Supplies	Flaming	10:43:00
VS5_030	Ops-11	Flaming Shipping Supplies	Flaming	10:00:00
VS5_008	Ops-13	Flaming Shipping Supplies	Flaming	14:17:00
VS5_033	Pway-20	Flaming Shipping Supplies	Flaming	14:25:00
VS5_008	3rd Deck-3	Flaming Trash Can	Flaming	14:17:00
VS5_015	ES-17	Flaming Trash Can	Flaming	10:43:00
VS5_039	Ops-11	Flaming Trash Can	Flaming	14:17:00
VS5_002	2nd Deck-7	Flaming Trash Can	Flaming	13:49:00
VS5_018	Ops-13	Flaming Trash Can	Flaming	14:14:00
VS5_017	Pway-14	Flaming Trash Can	Flaming	13:11:00
VS5_020	2nd Deck-7	IPA spill fire	Flaming	10:20:00
VS5_009	3rd Deck-2	IPA spill fire	Flaming	10:21:00
VS5_013	Ops-13	IPA spill fire	Flaming	8:45:00

VS5_007	Pway-16	IPA spill fire	Flaming	13:07:00
VS5_026	3rd Deck-2	Shielded IPA pan	Flaming	10:38:00
VS5_027	Ops-13	Shielded IPA pan	Flaming	12:23:00
VS5_018	3rd Deck-1	Shipping Supplies	Flaming	14:14:00
VS5_025	3rd Deck-3	Shipping Supplies	Flaming	9:31:00
VS5_029	ES-17	Wall board above 6 in. dia IPA pan fire	Flaming	8:36:00
VS5_007	3rd Deck-5	Gas Leak	Gas Release	13:07:00
VS5_003	2nd Deck-8	Gas release (N2 –100 psig)	Gas Release	14:31:30
VS5_023	2nd Deck-8	Gas release (N2 –250 psig)	Gas Release	14:30:00
VS5_025	Ops-11	Gas release (N2 –250 psig)	Gas Release	9:31:00
VS5_026	Ops-13	Gas release (N2 –250 psig)	Gas Release	10:38:00
VS5_025	PVLS-19	Gas release (N2 –250 psig)	Gas Release	9:31:00
VS5_024	Ops-11	Gas release (N2-C24100 psig)	Gas Release	8:38:00
VS5_010	3rd Deck-5	Gas release – N2 100 psig	Gas Release	11:53:00
VS5_002	2nd Deck-8	Gas Release (Air bursts)	Gas Release	13:49:00
VS5_014	Pway-14	Gas Release (Air)	Gas Release	9:30:00
VS5_008	Ops-11	Gas Release N2 100 psig	Gas Release	14:17:00
VS5_031	3rd Deck-3	Gas release-(Air constant)	Gas Release	11:03:00
VS5_033	Pway-14	Gas release-(Air constant)	Gas Release	14:25:00
VS5_028	2nd Deck-8	Gas release-small orifice (N2 –250 psig)	Gas Release	13:30:00
VS5_030	2nd Deck-9	SCBA	Gas Release	10:00:00
VS5_009	3rd Deck-5	SCBA	Gas Release	10:21:00
VS5_019	Ops-13	SCBA	Gas Release	9:03:00
VS5_021	2nd Deck-8	AM/FM Radio	Nuisance	12:03:00

VS5_017	3rd Deck-3	AM/FM Radio	Nuisance	13:11:00
VS5_031	PVLS-19	Arc Welding	Nuisance	11:03:00
VS5_021	3rd Deck-4	Engine Exhaust with Dewatering Pump	Nuisance	12:03:00
VS5_020	3rd Deck-3	Flash Photography	Nuisance	10:20:00
VS5_012	2nd Deck-8	Grinding Painted Steel	Nuisance	14:27:00
VS5_015	Ops-13	Grinding Painted Steel	Nuisance	10:43:00
VS5_038	PVLS-19	Grinding Painted Steel	Nuisance	13:25:00
VS5_039	Pway-14	Grinding Painted Steel	Nuisance	14:17:00
VS5_003	Ops-13	Heat Gun	Nuisance	14:31:30
VS5_018	Pway-14	People in space	Nuisance	14:14:00
VS5_034	All spaces except PVLS	People working	Nuisance	8:16:00
VS5_006	3rd Deck	People working in Space	Nuisance	12:06:00
VS5_039	Ops-23	Radio	Nuisance	14:17:00
VS5_020	2nd Deck-9	Space heater	Nuisance	10:20:00
VS5_014	3rd Deck-1	Space heater	Nuisance	9:30:00
VS5_035	3rd Deck-1	Space heater	Nuisance	9:29:00
VS5_024	Pway-14	Spilling bolts	Nuisance	8:38:00
VS5_019	2nd Deck-7 & 9	Spray Aerosol	Nuisance	9:03:00
VS5_016	2nd Deck-7 on cabinet	Toaster (Normal Toasting)	Nuisance	12:12:00
VS5_023	3rd Deck-1	Toaster (Normal Toasting)	Nuisance	14:30:00

VS5_009	Ops-23	Toaster: Normal Toasting	Nuisance	10:21:00
VS5_037	PVLS-15	Torch Cutting	Nuisance	12:31:00
VS5_001	2nd Deck-7	Torch Cutting Steel	Nuisance	11:12:00
VS5_019	3rd Deck-1	Torch Cutting Steel	Nuisance	9:03:00
VS5_026	Ops-10	Torch Cutting Steel	Nuisance	10:38:00
VS5_027	Pway-14	Torch Cutting Steel	Nuisance	12:23:00
VS5_011	3rd Deck-5	Torch Cutting Steel	Nuisance	13:49:00
VS5_010	Ops-23	TV	Nuisance	11:53:00
VS5_022	2nd Deck-9 & 7	Waving Materials	Nuisance	13:03:00
VS5_032	Ops-13	Waving Materials	Nuisance	12:35:00
VS5_023	2nd Deck-8	Welding	Nuisance	14:30:00
VS5_022	3rd Deck-3	Welding	Nuisance	13:03:00
VS5_002	Ops-11	Welding	Nuisance	13:49:00
VS5_036	PVLS-15	Welding	Nuisance	11:03:00
VS5_018	Ops-11	Welding	Nuisance	14:14:00
VS5_013	Ops-13	Welding	Nuisance	8:45:00
VS5_022	3rd Deck-4	Pipe rupture – 10" Gash 120 psig	Pipe Rupture	13:03:00
VS5_024	Ops-12	Pipe rupture - 10" Gash OH, 120 psig	Pipe Rupture	8:38:00
VS5_029	3rd Deck-4	Pipe rupture - 2" Gash, 120 psig	Pipe Rupture	8:36:00
VS5_038	3rd Deck-4	Pipe rupture – 9 hole 250 psig	Pipe Rupture	13:25:00
VS5_027	Ops-12	Pipe rupture – 9 hole 250 psig	Pipe Rupture	12:23:00
VS5_004	Ops-13	Pipe rupture – Gash 40 psig	Pipe Rupture	9:22:00

VS5_005	3rd Deck-4	Pipe rupture – Gash 60 psig	Pipe Rupture	10:36:00
VS5_005	Ops-13	Pipe rupture – Mist 60 psig	Pipe Rupture	10:36:00
VS5_011	Ops-13	Pipe Rupture – open pipe 120 psig	Pipe Rupture	13:49:00
VS5_020	3rd Deck-4	Pipe Rupture – open pipe OH 120 psig	Pipe Rupture	10:20:00
VS5_025	Ops-12	Pipe Rupture – open pipe OH 120 psig	Pipe Rupture	9:31:00
VS5_024	3rd Deck-4	Pipe rupture – Sprinkler 120 psig	Pipe Rupture	8:38:00
VS5_006	Ops-13	Pipe rupture – Sprinkler 60	Pipe Rupture	12:06:00
VS5_033	2nd Deck-8	Sprinkler/Mist System 250 psig (AM-11)	Pipe Rupture	14:25:00
VS5_021	2nd Deck	Sprinkler/Mist System 250 psig (AM-4)	Pipe Rupture	12:03:00
VS5_003	Ops-12	Water Aerosol -Mist 60 psig	Pipe Rupture	14:31:30
VS5_028	2nd Deck-9	2 Smoldering Boxes with Polystyrene Pellets	Smoldering	13:30:00
VS5_033	3rd Deck-6	Painted Bulkhead	Smoldering	14:25:00
VS5_039	3rd Deck-6	Painted Bulkhead with box targets	Smoldering	14:17:00
VS5_029	2nd Deck-8	Smoldering Cable Bundle	Smoldering	8:36:00
VS5_019	2nd Deck-9	Smoldering Cable Bundle	Smoldering	9:03:00
VS5_007	3rd Deck-4 on deck	Smoldering Cable Bundle	Smoldering	13:07:00
VS5_030	ES-17	Smoldering Cable Bundle	Smoldering	10:00:00
VS5_016	ES-18	Smoldering Cable Bundle	Smoldering	12:12:00
VS5_010	Ops-12	Smoldering Cable Bundle	Smoldering	11:53:00
VS5_015	Ops-13	Smoldering Cable Bundle	Smoldering	10:43:00
VS5_022	Pway-14	Smoldering Cable Bundle	Smoldering	13:03:00
VS5_029	Pway-20	Smoldering Cable Bundle	Smoldering	8:36:00
VS5_014	3rd Deck-1	Smoldering Laundry	Smoldering	9:30:00
VS5_021	Ops-11	Smoldering Laundry	Smoldering	12:03:00
VS5_013	2nd Deck-7	Smoldering Laundry	Smoldering	8:45:00
VS5_006	Ops-12	Smoldering Laundry	Smoldering	12:06:00

VS5_017	Ops-13	Smoldering Mattress	Smoldering	13:11:00
VS5_016	2nd Deck-8	Smoldering Mattress and Bedding	Smoldering	12:12:00
VS5_031	3rd Deck-5	Smoldering Mattress and Bedding	Smoldering	11:03:00
VS5_027	ES-18	Smoldering Mattress and Bedding	Smoldering	12:23:00
VS5_005	2nd Deck-7	Smoldering Oily rags	Smoldering	10:36:00
VS5_035	3rd Deck-21	Smoldering Oily Rags	Smoldering	9:29:00
VS5_017	3rd Deck-5	Smoldering Oily Rags	Smoldering	13:11:00
VS5_012	Ops-10	Smoldering Oily Rags	Smoldering	14:27:00
VS5_028	Ops-13	Smoldering Oily Rags	Smoldering	13:30:00
VS5_028	PVLS-15	Smoldering Oily Rags	Smoldering	13:30:00
VS5_026	Pway-14	Smoldering Oily Rags	Smoldering	10:38:00
VS5_032	Pway-20	Smoldering Oily Rags	Smoldering	12:35:00

Source Initiation	Source Transition	Source Termination	Data Collection Stopped	Event type
12:40:00		12:49:20	12:48:00	Flaming
13:30:00		13:35:11	13:39:00	Flaming
13:32:00		13:35:50	13:39:00	Flaming
12:38:00		12:42:11	12:48:00	Flaming
11:11:33		11:16:03	11:17:30	Flaming
9:37:00		9:41:55	10:20:00	Flaming
9:39:00		9:44:50	10:20:00	Flaming
11:10:02		11:14:30	11:17:30	Flaming
10:08:00		10:13:30	10:22:30	Flaming
9:28:00		9:38:30	9:38:30	Flaming
11:08:12		11:14:55	11:17:30	Flaming
12:36:13		12:48:13	12:48:00	Flaming
9:27:00		9:33:25	9:38:30	Flaming
14:30:20		14:33:52	14:50:30	Flaming
11:17:28		11:25:30	11:28:00	Flaming
12:17:00		12:31:00	12:31:00	Flaming
12:40:00		12:47:17	12:58:30	Flaming
14:35:00		14:37:15	14:44:00	Flaming
14:37:50		14:42:05	14:49:00	Flaming
10:48:00		10:56:45	11:10:05	Flaming
10:05:00		10:21:40	10:22:30	Flaming
14:22:00		14:33:00	14:34:00	Flaming
14:33:30		14:50:30	14:50:30	Flaming
14:23:00		14:34:00	14:34:00	Flaming
10:49:30		10:56:45	11:10:05	Flaming
14:30:45		14:39:08	14:36:00	Flaming
13:54:02		14:04:00	14:04:00	Flaming
14:26:30		14:33:40	14:33:40	Flaming
13:16:00		13:28:55	13:42:00	Flaming
10:33:07		10:38:00	10:38:00	Flaming
10:26:00		10:38:00	10:37:30	Flaming
9:00:34		9:02:30	9:02:30	Flaming

13:13:27		13:28:30	13:49:30	Flaming
10:43:00		10:49:55	10:58:00	Flaming
12:33:06		12:44:34	12:45:30	Flaming
14:19:00		14:33:40	14:33:40	Flaming
9:36:00		9:50:00	9:50:00	Flaming
8:41:03		8:49:50	9:03:00	Flaming
13:30:30		13:32:30	13:49:30	Gas Release
14:36:30		14:37:40	14:46:00	Gas Release
14:42:30		14:43:15	14:44:00	Gas Release
9:39:00		9:40:35	9:50:00	Gas Release
10:49:00		10:50:34	10:58:00	Gas Release
9:36:00		9:38:00	9:50:00	Gas Release
8:43:00		8:45:23	8:48:30	Gas Release
12:24:00		12:25:19	12:46:00	Gas Release
14:01:30		14:02:35	14:04:00	Gas Release
9:35:00		9:38:25	9:55:00	Gas Release
14:28:30		14:32:35	14:34:00	Gas Release
11:09:00		11:10:45	11:29:00	Gas Release
14:30:20		14:33:10	14:50:30	Gas Release
13:36:00		13:37:50	13:54:30	Gas Release
10:06:00		10:07:10	10:22:30	Gas Release
10:35:00		10:36:15	10:37:30	Gas Release
9:09:00		9:11:30	9:48:00	Gas Release
12:08:00		12:16:00	12:22:00	Nuisance

13:16:00		13:42:00	13:42:00	Nuisance
11:08:00		11:15:20	11:29:00	Nuisance
12:09:00		12:15:00	12:22:00	Nuisance
10:25:06		10:27:25	10:38:00	Nuisance
14:32:08		14:37:08	14:49:00	Nuisance
10:48:00		10:53:50	11:10:05	Nuisance
13:35:25		13:38:30	13:39:00	Nuisance
14:26:30		14:30:00	14:36:00	Nuisance
14:36:30		14:39:38	14:46:00	Nuisance
14:21:00		14:33:40	14:33:40	Nuisance
8:21:00		9:05:00	9:05:00	Nuisance
12:12:00		12:26:00	12:26:00	Nuisance
14:22:00		14:36:00	14:36:00	Nuisance
10:25:00		10:38:00	10:38:00	Nuisance
9:35:30		9:42:05	9:55:00	Nuisance
9:34:00		10:20:00	10:20:00	Nuisance
8:43:00		8:43:50	8:48:30	Nuisance
9:09:30		9:10:28	9:48:00	Nuisance
12:17:00		12:21:40	12:31:00	Nuisance
14:35:00		14:40:40	14:44:00	Nuisance

10:27:58		10:33:38	10:37:30	Nuisance
12:36:00		12:40:09	12:48:00	Nuisance
11:18:00		11:26:09	11:28:00	Nuisance
9:08:00		9:12:20	9:48:00	Nuisance
10:43:00		10:48:00	10:58:00	Nuisance
12:28:00		12:34:00	12:45:30	Nuisance
13:54:27		13:59:04	14:01:15	Nuisance
11:58:00		12:46:00	12:46:00	Nuisance
13:08:00		13:10:10	13:40:30	Nuisance
12:41:30		12:43:47	12:58:30	Nuisance
14:35:00		14:41:00	14:44:00	Nuisance
13:08:00		13:13:38	13:40:30	Nuisance
13:54:02		14:00:38	14:04:00	Nuisance
11:08:00		11:13:50	11:17:30	Nuisance
14:19:00		14:25:30	14:33:40	Nuisance
8:50:30		8:56:30	9:02:30	Nuisance
13:15:06		13:16:25	13:40:30	Pipe Rupture
8:46:08		8:47:56	8:48:30	Pipe Rupture
8:51:15		8:52:20	9:03:00	Pipe Rupture
13:32:35		13:34:50	13:39:00	Pipe Rupture
12:28:07		12:30:03	12:45:30	Pipe Rupture
9:34:00		9:36:48	9:38:30	Pipe Rupture

10:41:32		10:43:10	10:55:30	Pipe Rupture
10:45:00		10:54:12	10:55:30	Pipe Rupture
13:55:00		13:57:00	14:01:15	Pipe Rupture
10:29:13		10:30:13	10:38:00	Pipe Rupture
9:36:07		9:37:10	9:50:00	Pipe Rupture
8:43:00		8:44:40	8:48:30	Pipe Rupture
12:22:00		12:24:00	12:26:00	Pipe Rupture
14:33:52		14:35:47	14:50:30	Suppression System
12:19:09		12:20:55	12:22:00	Suppression System
14:40:30		14:46:00	14:46:00	Pipe Rupture
13:39:00		13:50:40	13:54:30	Smolder
14:31:00		14:40:35	14:50:30	Smolder
14:26:00		14:33:22	14:36:00	Smolder/ Flaming
8:43:23		9:03:00	9:03:00	Smolder
9:11:00		9:47:10	9:48:00	Smolder
13:12:00	13:37:50	13:48:50	13:49:30	Smolder
10:05:00		10:22:30	10:22:30	Smolder
12:18:30		12:31:00	12:31:00	Smolder
12:21:30		12:46:00	12:46:00	Fire Scenario
10:54:10		11:10:05	11:10:05	Smolder
13:08:00		13:40:30	13:40:30	Smolder
8:41:00		9:03:00	9:03:00	Smolder
9:42:00		9:55:00	9:55:00	Fire Scenario
12:08:00		12:22:00	12:22:00	Smolder
8:50:00		8:58:45	9:02:30	Fire Scenario
12:11:00	12:18:00	12:21:15	12:26:00	Smolder

13:19:00		13:27:20	13:42:00	Smolder
12:21:53		12:27:50	12:31:00	Smolder
11:08:00		11:29:00	11:29:00	Smolder
12:28:00		12:41:30	12:45:30	Smolder
10:41:32		10:55:05	10:55:30	Smolder
9:35:00		10:20:00	10:20:00	Smolder
13:23:00		13:42:00	13:42:00	Smolder
14:38:30		14:49:00	14:49:00	Smolder
13:35:00		13:49:07	13:54:30	Smolder
13:35:00		13:53:00	13:54:30	Smolder
10:43:00		10:58:00	10:58:00	Smolder
12:40:00	12:54:23	12:57:48	12:58:30	Smolder

		Electronic Space			3rd Deck Magazine			2nd Deck Magazine			Oppc
Test ID	**Start Data Collection**	**Ion**	**Photo**	**Multi**	**Ion**	**Photo**	**Multi**	**Ion**	**Photo**	**Multi**	**Ion**
VS5_001	11:12:00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VS5_002	13:49:00	DNA	DNA	DNA	DNA	DNA	DNA	95	330	175	DNA
VS5_003	14:31:30	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
VS5_004	9:22:00	DNA	DNA	DNA	35	235	180	DNA	DNA	DNA	0
VS5_005	10:36:00	DNA	DNA	DNA	DNA	DNA	DNA	915	590	615	DNA
VS5_006	12:06:00	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	805
VS5_007	13:07:00	DNA	DNA	DNA	1525	1900	1915	DNA	DNA	DNA	DNA
VS5_008	14:17:00	DNA	DNA	DNA	405	810	480	DNA	DNA	DNA	370
VS5_009	10:21:00	DNA	DNA	DNA	335	635	415	DNA	DNA	DNA	560
VS5_010	11:53:00	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
VS5_011	13:49:00	DNA	DNA	DNA	350	DNA	450	DNA	DNA	DNA	DNA
VS5_012	14:27:00	DNA	DNA	DNA	DNA	DNA	DNA	675	695	690	DNA
VS5_013	8:45:00	DNA	DNA	DNA	DNA	DNA	DNA	770	635	675	470
VS5_014	9:30:00	DNA	DNA	DNA	1325	1210	1245	DNA	DNA	DNA	DNA
VS5_015	10:43:00	435	640	515	735	DNA	850	415	DNA	935	1460
VS5_016	12:12:00	DNA	715	805	DNA	DNA	DNA	415	620	595	DNA
VS5_017	13:11:00	DNA	DNA	DNA	1660	1507	1380	DNA	DNA	DNA	770
VS5_018	14:14:00	DNA	DNA	DNA	435	DNA	DNA	DNA	DNA	DNA	485
VS5_019	9:03:00	DNA	DNA	DNA	345	DNA	505	DNA	1655	2440	DNA
VS5_020	10:20:00	DNA	DNA	DNA	DNA	DNA	DNA	815	1020	855	DNA
VS5_021	12:03:00	DNA	DNA	DNA	435	DNA	DNA	DNA	1005	DNA	1005
VS5_022	13:03:00	DNA	DNA	DNA	355	360	365	DNA	DNA	DNA	DNA
VS5_023	14:30:00	DNA	DNA	DNA	580	DNA	DNA	450	DNA	DNA	345
VS5_024	8:38:00	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
VS5_025	9:31:00	DNA	DNA	DNA	385	DNA	640	DNA	DNA	DNA	DNA
VS5_026	10:38:00	DNA	DNA	DNA	495	DNA	DNA	750	DNA	DNA	390
VS5_027	12:23:00	DNA	720	925	DNA	DNA	DNA	DNA	DNA	DNA	765
VS5_028	13:30:00	DNA	DNA	DNA	DNA	DNA	DNA	1115	945	895	1065
VS5_029	8:36:00	380	365	395	755	745	680	DNA	1220	DNA	DNA
VS5_030	10:00:00	DNA	765	930	DNA	DNA	DNA	535	580	580	430
VS5_031	11:03:00	DNA	DNA	DNA	665	775	670	DNA	DNA	DNA	DNA
VS5_032	12:35:00	DNA	DNA	DNA	DNA	DNA	DNA	430	465	460	DNA
VS5_033	14:25:00	DNA	950	DNA	475	490	495	415	505	455	460
VS5_034	8:16:00	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
VS5_035	9:29:00	DNA	2630	DNA	1855	2095	2470	645	685	670	505
VS5_036	11:03:00	DNA	DNA	DNA	385	455	495	540	550	555	460
VS5_037	12:31:00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
VS5_038	13:25:00	DNA	DNA	DNA	DNA	DNA	DNA	450	455	460	345
VS5_039	14:17:00	DNA	DNA	DNA	710	800	790	1020	DNA	DNA	680

rations Office		2nd Deck Passageway		
Photo	Multi	Ion	Photo	Multi
NA	NA	NA	NA	NA
DNA	DNA	120	215	260
DNA	DNA	DNA	DNA	DNA
18	18	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA
760	765	DNA	DNA	DNA
DNA	DNA	470	790	650
435	445	DNA	DNA	DNA
755	735	DNA	DNA	DNA
2910	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA
995	DNA	DNA	DNA	DNA
395	480	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA
1265	1215	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA
745	715	360	DNA	415
580	525	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA
850	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA
400	380	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA
DNA	430	DNA	735	875
DNA	885	365	DNA	430
755	880	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA
510	510	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA
DNA	DNA	1210	1080	1085
DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA
510	520	DNA	DNA	DNA
545	510	DNA	DNA	DNA
NA	NA	NA	NA	NA
495	450	DNA	DNA	DNA
940	930	DNA	DNA	DNA

Table of First Alarms for Data Fusion Algorithms

Data Fusion Objects
DF #0
DF #0
DF #1
DF #2
DF #3
DF #4

Test ID	Test Number	Compartment / ID String	Compartment Summary				
			FM	**FM**	**FM**	**FM**	**FM**
			Flame	*Smoke*	*Water*	*Thermal*	*Gas Release*
			Flame	**Smoke**	**Water**	**Thermal**	**Gas Release**
VS5T001	1	3MAG	11:19:09	11:21:34	DNA	DNA	DNA
VS5T001	1	2MAG	11:21:04	11:19:27	DNA	DNA	DNA
VS5T001	1	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T001	1	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T001	1	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T001	1	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T001	1	3MAG-SS#2	11:19:09	11:21:34	DNA	DNA	DNA
VS5T001	1	3MAG-SS#3	11:21:05	DNA	DNA	DNA	DNA
VS5T001	1	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T001	1	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T002	2	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T002	2	2MAG	DNA	13:58:53	DNA	DNA	DNA
VS5T002	2	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T002	2	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T002	2	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T002	2	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T002	2	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T002	2	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T002	2	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T002	2	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T003	3	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T003	3	2MAG	DNA	DNA	DNA	DNA	14:36:31
VS5T003	3	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T003	3	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T003	3	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T003	3	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T003	3	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T003	3	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T003	3	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T003	3	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T004	4	3MAG	9:36:11	9:35:14	DNA	DNA	DNA
VS5T004	4	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T004	4	2OPS	9:31:01	9:30:51	9:35:08	DNA	DNA
VS5T004	4	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T004	4	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T004	4	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T004	4	3MAG-SS#2	9:36:11	9:35:14	DNA	DNA	DNA
VS5T004	4	3MAG-SS#3	9:36:39	9:35:22	DNA	DNA	DNA
VS5T004	4	2OPS-SS#5	9:31:01	9:30:51	DNA	DNA	DNA
VS5T004	4	2OPS-SS#6	9:31:17	9:32:37	9:35:08	DNA	DNA
VS5T005	5	3MAG	DNA	DNA	10:42:01	DNA	DNA

VS5T005	5	2MAG	DNA	10:47:42	DNA	DNA	DNA
VS5T005	5	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T005	5	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T005	5	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T005	5	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T005	5	3MAG-SS#2	DNA	DNA	10:42:01	DNA	DNA
VS5T005	5	3MAG-SS#3	DNA	DNA	10:42:01	DNA	DNA
VS5T005	5	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T005	5	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T006	6	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T006	6	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T006	6	2OPS	DNA	12:18:39	12:22:48	DNA	DNA
VS5T006	6	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T006	6	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T006	6	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T006	6	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T006	6	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T006	6	2OPS-SS#5	DNA	12:18:39	DNA	DNA	DNA
VS5T006	6	2OPS-SS#6	DNA	12:22:59	12:22:48	DNA	DNA
VS5T007	7	3MAG	DNA	DNA	13:30:55	DNA	DNA
VS5T007	7	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T007	7	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T007	7	2PAS	13:23:39	DNA	DNA	DNA	DNA
VS5T007	7	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T007	7	3MAG-SS#1	DNA	DNA	13:30:55	DNA	DNA
VS5T007	7	3MAG-SS#2	DNA	DNA	13:30:56	DNA	DNA
VS5T007	7	3MAG-SS#3	DNA	DNA	13:31:02	DNA	DNA
VS5T007	7	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T007	7	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T008	8	3MAG	14:25:00	14:27:55	DNA	DNA	DNA
VS5T008	8	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T008	8	2OPS	14:23:33	14:28:48	DNA	DNA	DNA
VS5T008	8	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T008	8	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T008	8	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T008	8	3MAG-SS#2	14:25:00	DNA	DNA	DNA	DNA
VS5T008	8	3MAG-SS#3	DNA	14:27:55	DNA	DNA	DNA
VS5T008	8	2OPS-SS#5	14:28:36	14:28:48	DNA	DNA	DNA
VS5T008	8	2OPS-SS#6	14:23:33	DNA	DNA	DNA	DNA
VS5T009	9	3MAG	10:26:18	DNA	DNA	DNA	DNA
VS5T009	9	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T009	9	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T009	9	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T009	9	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T009	9	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T009	9	3MAG-SS#2	10:26:18	DNA	DNA	DNA	DNA
VS5T009	9	3MAG-SS#3	10:27:10	DNA	DNA	DNA	DNA
VS5T009	9	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T009	9	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T010	10	3MAG	DNA	DNA	DNA	DNA	12:24:37
VS5T010	10	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T010	10	2OPS	DNA	12:27:58	DNA	DNA	DNA

VS5T010	10	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T010	10	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T010	10	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T010	10	3MAG-SS#2	DNA	DNA	DNA	DNA	12:24:48
VS5T010	10	3MAG-SS#3	DNA	DNA	DNA	DNA	12:24:37
VS5T010	10	2OPS-SS#5	DNA	12:27:58	DNA	DNA	DNA
VS5T010	10	2OPS-SS#6	DNA	12:35:45	DNA	DNA	DNA
VS5T011	11	3MAG	13:57:08	13:57:57	DNA	DNA	DNA
VS5T011	11	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T011	11	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T011	11	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T011	11	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T011	11	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T011	11	3MAG-SS#2	13:57:08	DNA	DNA	DNA	DNA
VS5T011	11	3MAG-SS#3	DNA	13:57:57	DNA	DNA	DNA
VS5T011	11	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T011	11	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T012	12	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T012	12	2MAG	DNA	14:41:31	DNA	DNA	DNA
VS5T012	12	2OPS	DNA	14:42:50	DNA	DNA	DNA
VS5T012	12	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T012	12	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T012	12	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T012	12	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T012	12	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T012	12	2OPS-SS#5	DNA	14:42:50	DNA	DNA	DNA
VS5T012	12	2OPS-SS#6	DNA	14:43:20	DNA	DNA	DNA
VS5T013	13	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T013	13	2MAG	DNA	8:54:16	DNA	DNA	DNA
VS5T013	13	2OPS	9:00:49	8:58:35	DNA	DNA	DNA
VS5T013	13	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T013	13	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T013	13	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T013	13	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T013	13	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T013	13	2OPS-SS#5	9:00:58	8:54:56	DNA	DNA	DNA
VS5T013	13	2OPS-SS#6	9:00:49	9:01:16	DNA	DNA	DNA
VS5T014	14	3MAG	DNA	9:36:07	DNA	DNA	DNA
VS5T014	14	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T014	14	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T014	14	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T014	14	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T014	14	3MAG-SS#1	DNA	9:36:07	DNA	DNA	DNA
VS5T014	14	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T014	14	3MAG-SS#3	DNA	9:51:36	DNA	DNA	DNA
VS5T014	14	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T014	14	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T015	15	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T015	15	2MAG	10:52:56	10:52:25	DNA	DNA	DNA
VS5T015	15	2OPS	DNA	11:00:03	DNA	DNA	DNA
VS5T015	15	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T015	15	PVLS	DNA	DNA	DNA	DNA	DNA

VS5T015	15	3MAG-SS#1	DNA	10:51:49	DNA	DNA	DNA
VS5T015	15	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T015	15	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T015	15	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T015	15	2OPS-SS#6	DNA	10:52:57	DNA	DNA	DNA
VS5T016	16	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T016	16	2MAG	DNA	12:26:12	DNA	DNA	DNA
VS5T016	16	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T016	16	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T016	16	PVLS	12:21:09	12:22:32	DNA	DNA	DNA
VS5T016	16	3MAG-SS#1	DNA	12:23:08	DNA	DNA	DNA
VS5T016	16	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T016	16	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T016	16	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T016	16	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T017	17	3MAG	DNA	13:39:16	DNA	DNA	DNA
VS5T017	17	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T017	17	2OPS	DNA	13:25:53	DNA	DNA	DNA
VS5T017	17	2PAS	13:17:03	DNA	DNA	DNA	DNA
VS5T017	17	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T017	17	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T017	17	3MAG-SS#2	DNA	13:39:16	DNA	DNA	DNA
VS5T017	17	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T017	17	2OPS-SS#5	DNA	13:25:53	DNA	DNA	DNA
VS5T017	17	2OPS-SS#6	DNA	13:26:47	DNA	DNA	DNA
VS5T018	18	3MAG	14:21:42	DNA	DNA	DNA	DNA
VS5T018	18	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T018	18	2OPS	14:28:03	14:28:50	DNA	DNA	DNA
VS5T018	18	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T018	18	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T018	18	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T018	18	3MAG-SS#2	14:21:42	DNA	DNA	DNA	DNA
VS5T018	18	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T018	18	2OPS-SS#5	DNA	14:20:45	DNA	DNA	DNA
VS5T018	18	2OPS-SS#6	14:28:03	DNA	DNA	DNA	DNA
VS5T019	19	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T019	19	2MAG	DNA	9:24:40	DNA	DNA	DNA
VS5T019	19	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T019	19	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T019	19	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T019	19	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T019	19	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T019	19	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T019	19	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T019	19	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T020	20	3MAG	DNA	DNA	10:29:36	DNA	DNA
VS5T020	20	2MAG	10:33:26	10:37:44	DNA	DNA	DNA
VS5T020	20	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T020	20	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T020	20	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T020	20	3MAG-SS#1	DNA	DNA	10:29:36	DNA	DNA
VS5T020	20	3MAG-SS#2	DNA	DNA	10:29:38	DNA	DNA

VS5T020	20	3MAG-SS#3	DNA	DNA	10:29:36	DNA	DNA
VS5T020	20	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T020	20	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T021	21	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T021	21	2MAG	DNA	12:19:49	12:19:36	DNA	DNA
VS5T021	21	2OPS	DNA	12:11:19	DNA	DNA	DNA
VS5T021	21	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T021	21	PVLS	DNA	DNA	12:11:14	DNA	DNA
VS5T021	21	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T021	21	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T021	21	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T021	21	2OPS-SS#5	DNA	12:11:19	DNA	DNA	DNA
VS5T021	21	2OPS-SS#6	DNA	12:17:41	DNA	DNA	DNA
VS5T022	22	3MAG	DNA	DNA	13:15:35	DNA	DNA
VS5T022	22	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T022	22	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T022	22	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T022	22	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T022	22	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T022	22	3MAG-SS#2	DNA	DNA	13:15:35	DNA	DNA
VS5T022	22	3MAG-SS#3	DNA	DNA	13:15:35	DNA	DNA
VS5T022	22	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T022	22	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T023	23	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T023	23	2MAG	DNA	DNA	DNA	DNA	14:43:05
VS5T023	23	2OPS	14:35:36	14:36:38	DNA	DNA	DNA
VS5T023	23	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T023	23	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T023	23	3MAG-SS#1	DNA	14:35:38	DNA	DNA	DNA
VS5T023	23	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T023	23	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T023	23	2OPS-SS#5	14:35:42	14:36:38	DNA	DNA	DNA
VS5T023	23	2OPS-SS#6	14:35:36	14:37:58	DNA	DNA	DNA
VS5T024	24	3MAG	DNA	DNA	8:44:21	DNA	DNA
VS5T024	24	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T024	24	2OPS	DNA	DNA	8:46:28	DNA	DNA
VS5T024	24	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T024	24	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T024	24	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T024	24	3MAG-SS#2	DNA	DNA	8:44:21	DNA	DNA
VS5T024	24	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T024	24	2OPS-SS#5	DNA	DNA	8:46:28	DNA	DNA
VS5T024	24	2OPS-SS#6	DNA	DNA	8:46:29	DNA	DNA
VS5T025	25	3MAG	9:41:01	DNA	DNA	DNA	DNA
VS5T025	25	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T025	25	2OPS	DNA	DNA	9:36:28	DNA	9:40:19
VS5T025	25	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T025	25	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T025	25	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T025	25	3MAG-SS#2	9:41:01	DNA	DNA	DNA	DNA
VS5T025	25	3MAG-SS#3	9:49:00	DNA	DNA	DNA	DNA
VS5T025	25	2OPS-SS#5	DNA	DNA	9:36:28	DNA	9:40:36

VS5T025	25	2OPS-SS#6	DNA	DNA	9:36:28	DNA	9:40:19
VS5T026	26	3MAG	10:46:05	DNA	DNA	DNA	DNA
VS5T026	26	2MAG	DNA	DNA	DNA	DNA	10:49:51
VS5T026	26	2OPS	DNA	10:46:44	DNA	DNA	10:50:14
VS5T026	26	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T026	26	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T026	26	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T026	26	3MAG-SS#2	10:46:05	DNA	DNA	DNA	DNA
VS5T026	26	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T026	26	2OPS-SS#5	DNA	10:46:44	DNA	DNA	10:50:14
VS5T026	26	2OPS-SS#6	DNA	10:48:05	DNA	DNA	DNA
VS5T027	27	3MAG	DNA	12:40:56	DNA	DNA	DNA
VS5T027	27	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T027	27	2OPS	12:34:45	12:37:03	12:29:46	DNA	DNA
VS5T027	27	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T027	27	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T027	27	3MAG-SS#1	DNA	12:33:56	DNA	DNA	DNA
VS5T027	27	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T027	27	3MAG-SS#3	DNA	12:40:56	DNA	DNA	DNA
VS5T027	27	2OPS-SS#5	12:39:00	12:37:03	DNA	DNA	DNA
VS5T027	27	2OPS-SS#6	12:34:45	12:42:05	12:29:46	DNA	DNA
VS5T028	28	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T028	28	2MAG	DNA	13:45:34	DNA	DNA	13:37:32
VS5T028	28	2OPS	13:49:24	13:39:12	DNA	DNA	DNA
VS5T028	28	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T028	28	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T028	28	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T028	28	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T028	28	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T028	28	2OPS-SS#5	DNA	13:46:10	DNA	DNA	DNA
VS5T028	28	2OPS-SS#6	13:49:25	13:39:12	DNA	DNA	DNA
VS5T029	29	3MAG	DNA	8:46:45	8:51:55	DNA	DNA
VS5T029	29	2MAG	DNA	8:55:30	DNA	DNA	DNA
VS5T029	29	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T029	29	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T029	29	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T029	29	3MAG-SS#1	8:47:26	8:42:43	DNA	DNA	DNA
VS5T029	29	3MAG-SS#2	DNA	8:50:12	8:51:55	DNA	DNA
VS5T029	29	3MAG-SS#3	DNA	8:46:45	8:51:55	DNA	DNA
VS5T029	29	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T029	29	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T030	30	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T030	30	2MAG	10:12:24	10:11:01	DNA	DNA	10:06:33
VS5T030	30	2OPS	10:15:27	10:09:18	DNA	DNA	DNA
VS5T030	30	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T030	30	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T030	30	3MAG-SS#1	DNA	10:14:33	DNA	DNA	DNA
VS5T030	30	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T030	30	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T030	30	2OPS-SS#5	10:15:27	10:09:18	DNA	DNA	DNA
VS5T030	30	2OPS-SS#6	10:15:27	10:21:45	DNA	DNA	DNA
VS5T031	31	3MAG	DNA	11:19:34	DNA	DNA	11:10:03

VS5T031	31	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T031	31	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T031	31	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T031	31	PVLS	11:10:34	11:10:31	DNA	DNA	DNA
VS5T031	31	3MAG-SS#1	DNA	DNA	DNA	DNA	11:09:31
VS5T031	31	3MAG-SS#2	DNA	DNA	DNA	DNA	11:10:07
VS5T031	31	3MAG-SS#3	DNA	11:19:34	DNA	DNA	11:10:03
VS5T031	31	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T031	31	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T032	32	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T032	32	2MAG	12:43:46	12:42:57	DNA	DNA	DNA
VS5T032	32	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T032	32	2PAS	12:57:06	DNA	DNA	DNA	DNA
VS5T032	32	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T032	32	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T032	32	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T032	32	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T032	32	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T032	32	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T033	33	3MAG	14:38:04	14:33:59	DNA	DNA	DNA
VS5T033	33	2MAG	14:32:39	14:34:06	DNA	DNA	14:35:46
VS5T033	33	2OPS	DNA	14:36:12	DNA	DNA	DNA
VS5T033	33	2PAS	14:35:31	DNA	DNA	DNA	14:32:15
VS5T033	33	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T033	33	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T033	33	3MAG-SS#2	DNA	14:33:59	DNA	DNA	DNA
VS5T033	33	3MAG-SS#3	14:38:04	DNA	DNA	DNA	DNA
VS5T033	33	2OPS-SS#5	DNA	14:36:12	DNA	DNA	DNA
VS5T033	33	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T034	34	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T034	34	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T034	34	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T034	34	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T034	34	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T034	34	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T034	34	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T034	34	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T034	34	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T034	34	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T035	35	3MAG	DNA	10:01:13	DNA	DNA	DNA
VS5T035	35	2MAG	9:39:18	9:41:35	DNA	DNA	DNA
VS5T035	35	2OPS	9:37:19	9:37:54	DNA	DNA	DNA
VS5T035	35	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T035	35	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T035	35	3MAG-SS#1	DNA	10:17:55	DNA	DNA	DNA
VS5T035	35	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T035	35	3MAG-SS#3	DNA	10:01:13	DNA	DNA	DNA
VS5T035	35	2OPS-SS#5	9:37:20	9:37:54	DNA	DNA	DNA
VS5T035	35	2OPS-SS#6	9:37:19	9:38:17	DNA	DNA	DNA
VS5T036	36	3MAG	11:10:45	11:12:45	DNA	DNA	DNA
VS5T036	36	2MAG	11:11:51	11:12:16	DNA	DNA	DNA
VS5T036	36	2OPS	11:10:20	11:11:13	DNA	DNA	DNA

VS5T036	36	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T036	36	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T036	36	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T036	36	3MAG-SS#2	11:10:45	11:12:45	DNA	DNA	DNA
VS5T036	36	3MAG-SS#3	11:12:50	11:14:33	DNA	DNA	DNA
VS5T036	36	2OPS-SS#5	11:10:20	11:11:13	DNA	DNA	DNA
VS5T036	36	2OPS-SS#6	11:10:20	11:12:14	DNA	DNA	DNA
VS5T037	37	3MAG	12:46:13	12:42:32	DNA	DNA	DNA
VS5T037	37	2MAG	12:40:19	12:42:45	DNA	DNA	DNA
VS5T037	37	2OPS	12:38:18	12:39:02	DNA	DNA	DNA
VS5T037	37	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T037	37	PVLS	12:38:57	DNA	DNA	DNA	DNA
VS5T037	37	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T037	37	3MAG-SS#2	12:46:13	12:46:21	DNA	DNA	DNA
VS5T037	37	3MAG-SS#3	12:46:19	12:42:32	DNA	DNA	DNA
VS5T037	37	2OPS-SS#5	12:38:18	12:39:02	DNA	DNA	DNA
VS5T037	37	2OPS-SS#6	12:38:18	12:39:14	DNA	DNA	DNA
VS5T037	37	3MAG-BBPR	12:46:13	12:42:32	DNA	DNA	DNA
VS5T037	37	2MAG-BBPR	12:40:19	12:42:45	DNA	DNA	DNA
VS5T037	37	2OPS-BBPR	12:38:18	12:39:02	DNA	DNA	DNA
VS5T037	37	2PAS-BBPR	DNA	DNA	DNA	DNA	DNA
VS5T037	37	PVLS-BBPR	12:38:57	DNA	DNA	DNA	DNA
VS5T037	37	3ES-BBPR	DNA	DNA	DNA	DNA	DNA
VS5T038	38	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T038	38	2MAG	13:32:17	13:32:42	DNA	DNA	DNA
VS5T038	38	2OPS	13:30:24	13:31:35	DNA	DNA	DNA
VS5T038	38	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T038	38	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T038	38	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T038	38	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T038	38	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T038	38	2OPS-SS#5	13:30:30	13:31:35	DNA	DNA	DNA
VS5T038	38	2OPS-SS#6	13:30:24	13:33:45	DNA	DNA	DNA
VS5T038	38	3MAG-BBPR	DNA	DNA	DNA	DNA	DNA
VS5T038	38	2MAG-BBPR	13:32:17	13:32:42	DNA	DNA	DNA
VS5T038	38	2OPS-BBPR	13:30:17	13:31:35	DNA	DNA	DNA
VS5T038	38	2PAS-BBPR	DNA	DNA	DNA	DNA	DNA
VS5T038	38	PVLS-BBPR	DNA	DNA	DNA	DNA	DNA
VS5T038	38	3ES-BBPR	DNA	DNA	DNA	DNA	DNA
VS5T039	39	3MAG	DNA	DNA	DNA	DNA	DNA
VS5T039	39	2MAG	DNA	DNA	DNA	DNA	DNA
VS5T039	39	2OPS	DNA	DNA	DNA	DNA	DNA
VS5T039	39	2PAS	DNA	DNA	DNA	DNA	DNA
VS5T039	39	PVLS	DNA	DNA	DNA	DNA	DNA
VS5T039	39	3MAG-SS#1	DNA	DNA	DNA	DNA	DNA
VS5T039	39	3MAG-SS#2	DNA	DNA	DNA	DNA	DNA
VS5T039	39	3MAG-SS#3	DNA	DNA	DNA	DNA	DNA
VS5T039	39	2OPS-SS#5	DNA	DNA	DNA	DNA	DNA
VS5T039	39	2OPS-SS#6	DNA	DNA	DNA	DNA	DNA
VS5T039	39	3MAG-BBPR	14:29:45	DNA	DNA	DNA	DNA
VS5T039	39	2MAG-BBPR	DNA	DNA	DNA	DNA	DNA
VS5T039	39	2OPS-BBPR	DNA	DNA	DNA	DNA	DNA

VS5T039	39	2PAS-BBPR	DNA	DNA	DNA	DNA	DNA
VS5T039	39	PVLS-BBPR	DNA	DNA	DNA	DNA	DNA
VS5T039	39	3ES-BBPR	DNA	DNA	DNA	DNA	DNA

NOTE: *FM2 locked up during Test #39 at time 14:31:08. No fusion machine data is available afte*

DF Nuisance	
Chan. 1	SBVS Weld
Chan. 2	ACST Grind

DF Flame (same suite)	
Chan. 1	SBVS Fire FOV
Chan. 2	SBVS Fire + LWVD
Chan. 3	SBVS Fire + CVID Flame
Chan. 4	SBVS Fire + CVID Reflected

	DF Algorithm		***DF Algorithm***	***DF Algorithm***			
FM	**Nuisance**	**Nuisance**	**Bright Nuis.**	**Flame**	**Flame**	**Flame**	**Flame**
Suppression	*Chan.1*	*Chan.2*	*Chan.1*	*Chan.1*	*Chan.2*	*Chan.3*	*Chan.4*
Suppression	**Nuisance**	**Nuisance**	**Nuisance**	**Flame**	**Flame**	**Flame**	**Flame**
DNA	DNA	DNA	11:21:57	11:21:09	11:18:21	11:20:37	11:19:00
DNA	DNA	DNA	DNA	DNA	11:17:28	DNA	DNA
11:19:29	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	11:21:57	11:21:09	11:18:21	11:20:37	11:19:00
DNA	DNA	DNA	DNA	DNA	11:20:56	DNA	11:20:56
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
11:19:37	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	13:54:22	DNA	13:54:22	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	13:54:25	DNA	13:54:25	DNA	DNA	DNA	DNA
DNA	13:54:22	DNA	13:54:22	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
14:43:18	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
14:43:18	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	9:36:02	DNA	9:36:08
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
9:36:10	DNA	DNA	DNA	DNA	9:30:52	DNA	9:31:26
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	9:36:02	DNA	9:36:08
DNA	DNA	DNA	DNA	DNA	9:36:09	DNA	9:36:09
9:36:10	DNA	DNA	DNA	DNA	9:30:52	DNA	9:31:26
DNA	DNA	DNA	DNA	DNA	9:31:08	DNA	DNA
DNA	DNA	DNA	10:42:58	DNA	DNA	DNA	DNA

DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
10:48:46	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	10:42:58	DNA	DNA	DNA	DNA
DNA	DNA	DNA	10:45:02	DNA	DNA	DNA	DNA
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
10:48:46	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	12:19:48	DNA	DNA	DNA	DNA
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DNA	DNA	DNA	12:19:48	DNA	DNA	DNA	DNA
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	13:32:02	13:32:02	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
13:31:43	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	13:23:30	13:23:30	DNA
13:31:42	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	13:32:02	13:32:02	DNA	DNA	DNA	DNA
DNA	DNA	13:32:29	13:32:29	DNA	DNA	DNA	DNA
DNA	DNA	13:32:04	13:32:04	DNA	DNA	DNA	DNA
13:31:43	DNA	DNA	DNA	DNA	DNA	DNA	DNA
13:31:45	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	14:24:45	DNA	14:24:45
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	14:27:43	14:27:29	14:23:08	14:26:45	14:26:48
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	14:24:45	DNA	14:24:45
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	14:28:27	DNA	DNA
DNA	DNA	DNA	14:27:43	14:27:29	14:23:08	14:26:45	14:26:48
DNA	DNA	DNA	10:28:39	10:26:18	10:26:09	DNA	10:26:09
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	10:28:39	10:26:18	10:26:09	DNA	10:26:09
DNA	DNA	DNA	DNA	DNA	10:27:01	DNA	DNA
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	13:55:03	DNA	13:55:28	DNA	DNA
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13:56:10	DNA	DNA	DNA	DNA	DNA	DNA	DNA
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	13:55:03	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	13:55:28	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
13:56:10	DNA	DNA	DNA	DNA	DNA	DNA	DNA
13:56:10	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	14:32:38	14:32:38	DNA	DNA	DNA	DNA
DNA	DNA	14:32:20	14:32:20	DNA	DNA	DNA	DNA
DNA	DNA	14:35:16	14:35:16	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	14:35:18	14:35:18	DNA	DNA	DNA	DNA
DNA	DNA	14:32:38	14:32:38	DNA	DNA	DNA	DNA
DNA	DNA	14:35:16	14:35:16	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	8:50:51	DNA	8:50:51	9:00:41	9:00:40	DNA	9:00:52
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	8:51:24	DNA	9:00:49	DNA	DNA
DNA	8:50:51	DNA	8:50:51	9:00:41	9:00:40	DNA	9:00:52
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
9:36:46	DNA	DNA	DNA	9:30:22	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
9:36:52	DNA	DNA	DNA	DNA	DNA	DNA	DNA
9:36:46	DNA	DNA	DNA	9:30:22	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	10:49:39	10:49:39	DNA	10:52:47	DNA	10:52:47
DNA	DNA	10:48:44	10:48:44	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	10:48:44	10:48:44	DNA	DNA	DNA	DNA
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	12:21:00	12:21:59	12:21:59
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	13:17:36	13:16:23	DNA
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	14:21:13	14:24:54	14:21:33	14:22:25	14:23:02
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	14:19:21	DNA	14:19:21	14:29:51	14:27:54	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	14:23:15	14:24:54	14:21:33	14:22:25	14:23:02
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DNA	14:21:46	DNA	14:21:46	DNA	DNA	DNA	DNA
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DF Flame (cross suite)*		DF Smoke	
Chan. 1	SBVS Fire + LWVD	*Chan. 1*	CVID Smoke
Chan. 2	SBVS Fire + CVID Flame	*Chan. 2*	SBVS Smoke
Chan. 3	SBVS Fire + CVID Reflected		

** Cross suite only logged when same suite absent.*

DF Algorithm			***DF Algorithm***		***DF Algorithm***	***DF Algorithm***
XFlame	**XFlame**	**XFlame**	**Smoke**	**Smoke**	**Water**	**Gas Release**
Chan.1	*Chan.2*	*Chan.3*	*Chan.1*	*Chan.2*	*Chan.1*	*Chan.1*
Flame	**Flame**	**Flame**	**Smoke**	**Smoke**	**Water**	**Gas Release**
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DNA	DNA	DNA	DNA	DNA	12:11:05	DNA
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DNA	DNA	DNA	12:14:45	12:11:10	DNA	DNA
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DNA	DNA	DNA	14:36:28	14:36:56	DNA	DNA
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DNA	DNA	DNA	14:36:28	14:36:56	DNA	DNA
DNA	DNA	DNA	DNA	14:37:49	DNA	DNA
DNA	DNA	DNA	DNA	DNA	8:44:12	DNA
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DNA	DNA	DNA	DNA	DNA	9:36:19	9:40:10
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10:46:42	DNA	DNA	10:46:53	10:46:36	DNA	10:50:05
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DNA	DNA	DNA	DNA	DNA	12:29:59	DNA
DNA	DNA	DNA	12:36:54	DNA	12:29:37	DNA
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DNA	DNA	DNA	DNA	12:40:47	DNA	DNA
DNA	DNA	DNA	12:36:54	DNA	DNA	DNA
DNA	DNA	DNA	12:41:56	DNA	12:29:37	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	13:45:25	DNA	13:37:18
DNA	DNA	DNA	13:46:05	13:39:03	DNA	DNA
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DNA	DNA	DNA	DNA	13:30:03	DNA	DNA
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DNA	DNA	DNA	13:46:05	13:46:01	DNA	DNA
DNA	DNA	DNA	13:49:57	13:39:03	DNA	DNA
DNA	DNA	DNA	8:50:03	8:46:36	8:51:46	DNA
DNA	DNA	DNA	DNA	8:55:21	DNA	DNA
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DNA	DNA	DNA	8:43:09	8:42:34	DNA	DNA
DNA	DNA	DNA	8:50:03	DNA	8:51:46	DNA
DNA	DNA	DNA	DNA	8:46:36	8:51:46	DNA
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DNA	DNA	DNA	10:13:32	10:10:52	DNA	10:06:24
DNA	DNA	DNA	10:09:09	10:13:17	DNA	DNA
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DNA	DNA	DNA	DNA	11:19:25	DNA	11:09:54

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DNA	DNA	DNA	14:25:23	DNA	DNA	14:35:37
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DNA	DNA	DNA	10:17:46	DNA	DNA	DNA
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DNA	DNA	DNA	9:37:51	9:37:45	DNA	DNA
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DNA	DNA	DNA	11:12:36	11:13:52	DNA	DNA
DNA	DNA	DNA	11:12:07	DNA	DNA	DNA
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DNA	DNA	DNA	11:11:04	11:13:02	DNA	DNA
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DNA	DNA	DNA	12:46:12	12:42:23	DNA	DNA
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13:31:09	DNA	DNA	13:31:26	DNA	DNA	DNA
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DF Algorithm	*DF Algorithm*					
Suppression	***Bayesian Belief Pattern Recognition (BBPR) Resu***					
Chan.1	*Class 1*	*Class 2*	*Class 3*	*Class 4*	*Class 5*	*Class 6*
Suppression	**Fire**	**Bright Nuisance**	**Water**	**Gas Release**	**Suppression**	**Engine**
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DNA	12:40:03	DNA	DNA	DNA	DNA	DNA
DNA	12:38:02	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA
12:37:27	12:37:46	12:36:01	DNA	DNA	DNA	DNA
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DNA	DNA	DNA	DNA	DNA	DNA	13:35:04
DNA	13:32:07	DNA	DNA	DNA	DNA	DNA
13:33:15	13:30:02	13:32:47	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA
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DNA	14:29:30	DNA	DNA	DNA	DNA	DNA
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DNA	14:31:02	DNA	DNA	DNA	DNA	DNA

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DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA

ults		
Class 7	*Class 8*	*Class 9*
Grinding	**Background**	**People**

DNA	12:31:24	12:34:57
DNA	12:31:25	12:38:11
DNA	12:31:24	12:36:55
DNA	12:31:23	DNA
DNA	12:31:24	12:34:11
DNA	12:31:23	DNA

DNA	13:25:23	13:31:25
DNA	13:25:23	13:30:11
DNA	13:25:25	13:28:52
DNA	13:25:23	13:30:11
13:35:49	13:25:23	13:29:42
DNA	13:25:23	13:31:27

DNA	14:17:27	14:26:50
DNA	14:17:29	14:30:36
DNA	14:17:26	14:21:28

14:26:37	14:17:23	14:26:32
DNA	14:17:23	DNA
DNA	14:17:24	DNA

Table of First Alarms for Data Fusion Algorithms

Data	*DF #0*	*3MAG:*	*SS #2,#3 (Tests 1 - 14 adjusted to not include SS#1)*
Fusion	*DF #0*	*3MAG:*	*SS #2,#3 (Tests 15 and up)*
Objects	*DF #1*	*2MAG:*	*SS #4*
	DF #2	*2OPS:*	*SS #5,#6*
	DF #3	*2PAS:*	*SS #7*
	DF #4	*PVLS:*	*SS#8*
	DF #5	*3ES:*	*SS#1*

			Compartment Source #1				
Test ID	Test Number	Date	Compartment - Location	Source Description	Source Type	Source Category	Source Start Time
VS5T001	1	7/26/2005	3rd Deck-3	4 Flaming Car	Flaming	20	11:17:28
VS5T001	1	7/26/2005	2nd Deck-7	Torch Cutting	Nuisance	12	11:18:00
VS5T001	1	7/26/2005			No Source	98	
VS5T001	1	7/26/2005			No Source	98	
VS5T001	1	7/26/2005			No Source	98	
VS5T001	1	7/26/2005			No Source	98	
VS5T001	1	7/26/2005	3rd Deck-3	4 Flaming Car	Flaming	20	11:17:28
VS5T001	1	7/26/2005	3rd Deck-3	4 Flaming Car	Flaming	20	11:17:28
VS5T001	1	7/26/2005			No Source	98	
VS5T001	1	7/26/2005			No Source	98	
VS5T002	2	7/26/2005			No Source	98	
VS5T002	2	7/26/2005	2nd Deck-7	Flaming Trash	Flaming	20	13:54:02
VS5T002	2	7/26/2005	Ops-11	Welding	Nuisance	11	13:54:02
VS5T002	2	7/26/2005			No Source	98	
VS5T002	2	7/26/2005			No Source	98	
VS5T002	2	7/26/2005			No Source	98	
VS5T002	2	7/26/2005			No Source	98	
VS5T002	2	7/26/2005			No Source	98	
VS5T002	2	7/26/2005	Ops-11	Welding	Nuisance	11	13:54:02
VS5T002	2	7/26/2005	Ops-11	Welding	Nuisance	11	13:54:02
VS5T003	3	7/26/2005			No Source	98	
VS5T003	3	7/26/2005	2nd Deck-8	Gas release (	Gas Release	60	14:36:30
VS5T003	3	7/26/2005	Ops-13	Heat Gun	Nuisance	15	14:36:30
VS5T003	3	7/26/2005			No Source	98	
VS5T003	3	7/26/2005			No Source	98	
VS5T003	3	7/26/2005			No Source	98	
VS5T003	3	7/26/2005			No Source	98	
VS5T003	3	7/26/2005			No Source	98	
VS5T003	3	7/26/2005	Ops-13	Heat Gun	Nuisance	15	14:36:30
VS5T003	3	7/26/2005	Ops-13	Heat Gun	Nuisance	15	14:36:30
VS5T004	4	7/27/2005	3rd Deck-5	2 Flaming Box	Flaming	20	9:28:00
VS5T004	4	7/27/2005			No Source	98	

VS5T004	4	7/27/2005	Ops-11	2 Flaming Car	Flaming	20	9:27:00
VS5T004	4	7/27/2005			No Source	98	
VS5T004	4	7/27/2005			No Source	98	
VS5T004	4	7/27/2005			No Source	98	
VS5T004	4	7/27/2005	3rd Deck-5	2 Flaming Box	Flaming	20	9:28:00
VS5T004	4	7/27/2005	3rd Deck-5	2 Flaming Box	Flaming	20	9:28:00
VS5T004	4	7/27/2005	Ops-11	2 Flaming Car	Flaming	20	9:27:00
VS5T004	4	7/27/2005	Ops-11	2 Flaming Car	Flaming	20	9:27:00
VS5T005	5	7/27/2005	3rd Deck-4	Pipe rupture –	Pipe Rupture	40	10:41:32
VS5T005	5	7/27/2005	2nd Deck-7	Smoldering Oi	Smolder	30	10:41:32
VS5T005	5	7/27/2005	Ops-13	Pipe rupture –	Pipe Rupture	40	10:45:00
VS5T005	5	7/27/2005			No Source	98	
VS5T005	5	7/27/2005			No Source	98	
VS5T005	5	7/27/2005			No Source	98	
VS5T005	5	7/27/2005	3rd Deck-4	Pipe rupture –	Pipe Rupture	40	10:41:32
VS5T005	5	7/27/2005	3rd Deck-4	Pipe rupture –	Pipe Rupture	40	10:41:32
VS5T005	5	7/27/2005	Ops-13	Pipe rupture –	Pipe Rupture	40	10:45:00
VS5T005	5	7/27/2005	Ops-13	Pipe rupture –	Pipe Rupture	40	10:45:00
VS5T006	6	7/27/2005	3rd Deck	People workin	Nuisance	10	12:12:00
VS5T006	6	7/27/2005			No Source	98	
VS5T006	6	7/27/2005	Ops-12	Smoldering La	Smolder	32	12:11:00
VS5T006	6	7/27/2005			No Source	98	
VS5T006	6	7/27/2005			No Source	98	
VS5T006	6	7/27/2005			No Source	98	
VS5T006	6	7/27/2005	3rd Deck	People workin	Nuisance	10	12:12:00
VS5T006	6	7/27/2005	3rd Deck	People workin	Nuisance	10	12:12:00
VS5T006	6	7/27/2005	Ops-12	Smoldering La	Smolder	32	12:11:00
VS5T006	6	7/27/2005	Ops-12	Smoldering La	Smolder	32	12:11:00
VS5T007	7	7/27/2005	3rd Deck-4 on deck	Smoldering Ca	Smolder	32	13:12:00
VS5T007	7	7/27/2005			No Source	98	
VS5T007	7	7/27/2005			No Source	98	
VS5T007	7	7/27/2005	Pway-16	IPA spill fire	Flaming	20	13:13:27
VS5T007	7	7/27/2005			No Source	98	
VS5T007	7	7/27/2005			No Source	98	
VS5T007	7	7/27/2005	3rd Deck-4 on deck	Smoldering Ca	Smolder	32	13:12:00
VS5T007	7	7/27/2005	3rd Deck-4 on deck	Smoldering Ca	Smolder	32	13:12:00
VS5T007	7	7/27/2005			No Source	98	
VS5T007	7	7/27/2005			No Source	98	
VS5T008	8	7/27/2005	3rd Deck-3	Flaming Trash	Flaming	20	14:23:00

VS5T008	8	7/27/2005			No Source	98	
VS5T008	8	7/27/2005	Ops-13	Flaming Shipp	Flaming	20	14:22:00
VS5T008	8	7/27/2005			No Source	98	
VS5T008	8	7/27/2005			No Source	98	
VS5T008	8	7/27/2005			No Source	98	
VS5T008	8	7/27/2005	3rd Deck-3	Flaming Trash	Flaming	20	14:23:00
VS5T008	8	7/27/2005	3rd Deck-3	Flaming Trash	Flaming	20	14:23:00
VS5T008	8	7/27/2005	Ops-13	Flaming Shipp	Flaming	20	14:22:00
VS5T008	8	7/27/2005	Ops-13	Flaming Shipp	Flaming	20	14:22:00
VS5T009	9	7/28/2005	3rd Deck-2	IPA spill fire	Flaming	20	10:26:00
VS5T009	9	7/28/2005			No Source	98	
VS5T009	9	7/28/2005	Ops-23	Toaster: Norm	Nuisance	15	10:27:58
VS5T009	9	7/28/2005			No Source	98	
VS5T009	9	7/28/2005			No Source	98	
VS5T009	9	7/28/2005			No Source	98	
VS5T009	9	7/28/2005	3rd Deck-2	IPA spill fire	Flaming	20	10:26:00
VS5T009	9	7/28/2005	3rd Deck-2	IPA spill fire	Flaming	20	10:26:00
VS5T009	9	7/28/2005	Ops-23	Toaster: Norm	Nuisance	15	10:27:58
VS5T009	9	7/28/2005	Ops-23	Toaster: Norm	Nuisance	15	10:27:58
VS5T010	10	7/28/2005	3rd Deck-5	Gas release – N	Gas Release	60	12:24:00
VS5T010	10	7/28/2005			No Source	98	
VS5T010	10	7/28/2005	Ops-23	TV	Nuisance	10	11:58:00
VS5T010	10	7/28/2005			No Source	98	
VS5T010	10	7/28/2005			No Source	98	
VS5T010	10	7/28/2005			No Source	98	
VS5T010	10	7/28/2005	3rd Deck-5	Gas release – N	Gas Release	60	12:24:00
VS5T010	10	7/28/2005	3rd Deck-5	Gas release – N	Gas Release	60	12:24:00
VS5T010	10	7/28/2005	Ops-23	TV	Nuisance	10	11:58:00
VS5T010	10	7/28/2005	Ops-23	TV	Nuisance	10	11:58:00
VS5T011	11	7/28/2005	3rd Deck-5	Torch Cutting	Nuisance	12	13:54:27
VS5T011	11	7/28/2005			No Source	98	
VS5T011	11	7/28/2005	Ops-13	Pipe Rupture –	Pipe Rupture	40	13:55:00
VS5T011	11	7/28/2005			No Source	98	
VS5T011	11	7/28/2005			No Source	98	
VS5T011	11	7/28/2005			No Source	98	
VS5T011	11	7/28/2005	3rd Deck-5	Torch Cutting	Nuisance	12	13:54:27
VS5T011	11	7/28/2005	3rd Deck-5	Torch Cutting	Nuisance	12	13:54:27
VS5T011	11	7/28/2005	Ops-13	Pipe Rupture –	Pipe Rupture	40	13:55:00
VS5T011	11	7/28/2005	Ops-13	Pipe Rupture –	Pipe Rupture	40	13:55:00

VS5T012	12	7/28/2005			No Source	98	
VS5T012	12	7/28/2005	2nd Deck-8	Grinding Paint	Nuisance	13	14:32:08
VS5T012	12	7/28/2005	Ops-10	Smoldering Oi	Smolder	30	14:38:30
VS5T012	12	7/28/2005			No Source	98	
VS5T012	12	7/28/2005			No Source	98	
VS5T012	12	7/28/2005			No Source	98	
VS5T012	12	7/28/2005			No Source	98	
VS5T012	12	7/28/2005			No Source	98	
VS5T012	12	7/28/2005	Ops-10	Smoldering Oi	Smolder	30	14:38:30
VS5T012	12	7/28/2005	Ops-10	Smoldering Oi	Smolder	30	14:38:30
VS5T013	13	7/29/2005			No Source	98	
VS5T013	13	7/29/2005	2nd Deck-7	Smoldering La	Fire Scenario	30	8:50:00
VS5T013	13	7/29/2005	Ops-13	Welding	Nuisance	11	8:50:30
VS5T013	13	7/29/2005			No Source	98	
VS5T013	13	7/29/2005			No Source	98	
VS5T013	13	7/29/2005			No Source	98	
VS5T013	13	7/29/2005			No Source	98	
VS5T013	13	7/29/2005			No Source	98	
VS5T013	13	7/29/2005	Ops-13	Welding	Nuisance	11	8:50:30
VS5T013	13	7/29/2005	Ops-13	Welding	Nuisance	11	8:50:30
VS5T014	14	7/29/2005	3rd Deck-1	Space heater	Nuisance	15	9:35:30
VS5T014	14	7/29/2005			No Source	98	
VS5T014	14	7/29/2005			No Source	98	
VS5T014	14	7/29/2005	Pway-14	Gas Release (A	Gas Release	60	9:35:00
VS5T014	14	7/29/2005			No Source	98	
VS5T014	14	7/29/2005			No Source	98	
VS5T014	14	7/29/2005	3rd Deck-1	Space heater	Nuisance	15	9:35:30
VS5T014	14	7/29/2005	3rd Deck-1	Space heater	Nuisance	15	9:35:30
VS5T014	14	7/29/2005			No Source	98	
VS5T014	14	7/29/2005			No Source	98	
VS5T015	15	7/29/2005			No Source	98	
VS5T015	15	7/29/2005	2nd Deck-8	Flaming Shipp	Flaming	20	10:48:00
VS5T015	15	7/29/2005	Ops-13	Grinding Paint	Nuisance	13	10:48:00
VS5T015	15	7/29/2005			No Source	98	
VS5T015	15	7/29/2005			No Source	98	
VS5T015	15	7/29/2005	ES-17	Flaming Trash	Flaming	20	10:49:30
VS5T015	15	7/29/2005			No Source	98	
VS5T015	15	7/29/2005			No Source	98	
VS5T015	15	7/29/2005	Ops-13	Grinding Paint	Nuisance	13	10:48:00
VS5T015	15	7/29/2005	Ops-13	Grinding Paint	Nuisance	13	10:48:00

VS5T016	16	7/29/2005			No Source	98	
VS5T016	16	7/29/2005	2nd Deck-7 on cabinet	Toaster (Norm	Nuisance	15	12:17:00
VS5T016	16	7/29/2005			No Source	98	
VS5T016	16	7/29/2005			No Source	98	
VS5T016	16	7/29/2005	PVLS Deck-15	4 Flaming Car	Flaming	20	12:17:00
VS5T016	16	7/29/2005	ES-18	Smoldering Ca	Smolder	30	12:18:30
VS5T016	16	7/29/2005			No Source	98	
VS5T016	16	7/29/2005			No Source	98	
VS5T016	16	7/29/2005			No Source	98	
VS5T016	16	7/29/2005			No Source	98	
VS5T017	17	7/29/2005	3rd Deck-3	AM/FM Radio	Nuisance	10	13:16:00
VS5T017	17	7/29/2005			No Source	98	
VS5T017	17	7/29/2005	Ops-13	Smoldering M	Smolder	30	13:19:00
VS5T017	17	7/29/2005	Pway-14	Flaming Trash	Flaming	20	13:16:00
VS5T017	17	7/29/2005			No Source	98	
VS5T017	17	7/29/2005			No Source	98	
VS5T017	17	7/29/2005	3rd Deck-3	AM/FM Radio	Nuisance	10	13:16:00
VS5T017	17	7/29/2005	3rd Deck-3	AM/FM Radio	Nuisance	10	13:16:00
VS5T017	17	7/29/2005	Ops-13	Smoldering M	Smolder	30	13:19:00
VS5T017	17	7/29/2005	Ops-13	Smoldering M	Smolder	30	13:19:00
VS5T018	18	7/29/2005	3rd Deck-1	Shipping Supp	Flaming	20	14:19:00
VS5T018	18	7/29/2005			No Source	98	
VS5T018	18	7/29/2005	Ops-11	Welding	Nuisance	11	14:19:00
VS5T018	18	7/29/2005	Pway-14	People in spac	Nuisance	10	14:21:00
VS5T018	18	7/29/2005			No Source	98	
VS5T018	18	7/29/2005			No Source	98	
VS5T018	18	7/29/2005	3rd Deck-1	Shipping Supp	Flaming	20	14:19:00
VS5T018	18	7/29/2005	3rd Deck-1	Shipping Supp	Flaming	20	14:19:00
VS5T018	18	7/29/2005	Ops-11	Welding	Nuisance	11	14:19:00
VS5T018	18	7/29/2005	Ops-11	Welding	Nuisance	11	14:19:00
VS5T019	19	8/1/2005	3rd Deck-1	Torch Cutting	Nuisance	12	9:08:00
VS5T019	19	8/1/2005	2nd Deck-7 & 9	Spray Aerosol	Nuisance	10	9:09:30
VS5T019	19	8/1/2005	Ops-13	SCBA	Gas Release	60	9:09:00
VS5T019	19	8/1/2005			No Source	98	
VS5T019	19	8/1/2005			No Source	98	
VS5T019	19	8/1/2005			No Source	98	
VS5T019	19	8/1/2005	3rd Deck-1	Torch Cutting	Nuisance	12	9:08:00
VS5T019	19	8/1/2005	3rd Deck-1	Torch Cutting	Nuisance	12	9:08:00
VS5T019	19	8/1/2005	Ops-13	SCBA	Gas Release	60	9:09:00

VS5T019	19	8/1/2005	Ops-13	SCBA	Gas Release	60	9:09:00
VS5T020	20	8/1/2005	3rd Deck-3	Flash Photogra	Nuisance	10	10:25:06
VS5T020	20	8/1/2005	2nd Deck-9	Space heater	Nuisance	15	10:25:00
VS5T020	20	8/1/2005			No Source	98	
VS5T020	20	8/1/2005			No Source	98	
VS5T020	20	8/1/2005			No Source	98	
VS5T020	20	8/1/2005			No Source	98	
VS5T020	20	8/1/2005	3rd Deck-3	Flash Photogra	Nuisance	10	10:25:06
VS5T020	20	8/1/2005	3rd Deck-3	Flash Photogra	Nuisance	10	10:25:06
VS5T020	20	8/1/2005			No Source	98	
VS5T020	20	8/1/2005			No Source	98	
VS5T021	21	8/1/2005	3rd Deck-4	Engine Exhaus	Nuisance	14	12:09:00
VS5T021	21	8/1/2005	2nd Deck-8	AM/FM Radio	Nuisance	10	12:08:00
VS5T021	21	8/1/2005	Ops-11	Smoldering La	Smolder	30	12:08:00
VS5T021	21	8/1/2005			No Source	98	
VS5T021	21	8/1/2005			No Source	98	
VS5T021	21	8/1/2005			No Source	98	
VS5T021	21	8/1/2005	3rd Deck-4	Engine Exhaus	Nuisance	14	12:09:00
VS5T021	21	8/1/2005	3rd Deck-4	Engine Exhaus	Nuisance	14	12:09:00
VS5T021	21	8/1/2005	Ops-11	Smoldering La	Smolder	30	12:08:00
VS5T021	21	8/1/2005	Ops-11	Smoldering La	Smolder	30	12:08:00
VS5T022	22	8/1/2005	3rd Deck-3	Welding	Nuisance	11	13:08:00
VS5T022	22	8/1/2005	2nd Deck-9 & 7	Waving Mater	Nuisance	10	13:08:00
VS5T022	22	8/1/2005			No Source	98	
VS5T022	22	8/1/2005	Pway-14	Smoldering Ca	Smolder	30	13:08:00
VS5T022	22	8/1/2005			No Source	98	
VS5T022	22	8/1/2005			No Source	98	
VS5T022	22	8/1/2005	3rd Deck-3	Welding	Nuisance	11	13:08:00
VS5T022	22	8/1/2005	3rd Deck-3	Welding	Nuisance	11	13:08:00
VS5T022	22	8/1/2005			No Source	98	
VS5T022	22	8/1/2005			No Source	98	
VS5T023	23	8/1/2005	3rd Deck-1	Toaster (Norm	Nuisance	15	14:35:00
VS5T023	23	8/1/2005	2nd Deck-8	Welding	Nuisance	11	14:35:00
VS5T023	23	8/1/2005	Ops-11	Crumpled new	Flaming	20	14:35:00
VS5T023	23	8/1/2005			No Source	98	
VS5T023	23	8/1/2005			No Source	98	
VS5T023	23	8/1/2005			No Source	98	
VS5T023	23	8/1/2005	3rd Deck-1	Toaster (Norm	Nuisance	15	14:35:00
VS5T023	23	8/1/2005	3rd Deck-1	Toaster (Norm	Nuisance	15	14:35:00

VS5T023	23	8/1/2005	Ops-11	Crumpled new	Flaming	20	14:35:00
VS5T023	23	8/1/2005	Ops-11	Crumpled new	Flaming	20	14:35:00
VS5T024	24	8/2/2005	3rd Deck-4	Pipe rupture –	Pipe Rupture	40	8:43:00
VS5T024	24	8/2/2005			No Source	98	
VS5T024	24	8/2/2005	Ops-11	Gas release (	Gas Release	60	8:43:00
VS5T024	24	8/2/2005	Pway-14	Spilling bolts	Nuisance	10	8:43:00
VS5T024	24	8/2/2005			No Source	98	
VS5T024	24	8/2/2005			No Source	98	
VS5T024	24	8/2/2005	3rd Deck-4	Pipe rupture –	Pipe Rupture	40	8:43:00
VS5T024	24	8/2/2005	3rd Deck-4	Pipe rupture –	Pipe Rupture	40	8:43:00
VS5T024	24	8/2/2005	Ops-11	Gas release (	Gas Release	60	8:43:00
VS5T024	24	8/2/2005	Ops-11	Gas release (	Gas Release	60	8:43:00
VS5T025	25	8/2/2005	3rd Deck-3	Shipping Supp	Flaming	20	9:36:00
VS5T025	25	8/2/2005			No Source	98	
VS5T025	25	8/2/2005	Ops-12	Pipe Rupture –	Pipe Rupture	40	9:36:07
VS5T025	25	8/2/2005			No Source	98	
VS5T025	25	8/2/2005	PVLS-19	Gas release (	Gas Release	60	9:36:00
VS5T025	25	8/2/2005			No Source	98	
VS5T025	25	8/2/2005	3rd Deck-3	Shipping Supp	Flaming	20	9:36:00
VS5T025	25	8/2/2005	3rd Deck-3	Shipping Supp	Flaming	20	9:36:00
VS5T025	25	8/2/2005	Ops-12	Pipe Rupture –	Pipe Rupture	40	9:36:07
VS5T025	25	8/2/2005	Ops-12	Pipe Rupture –	Pipe Rupture	40	9:36:07
VS5T026	26	8/2/2005	3rd Deck-2	Shielded IPA p	Flaming	20	10:43:00
VS5T026	26	8/2/2005			No Source	98	
VS5T026	26	8/2/2005	Ops-10	Torch Cutting	Nuisance	12	10:43:00
VS5T026	26	8/2/2005	Pway-14	Smoldering Oi	Smolder	30	10:43:00
VS5T026	26	8/2/2005			No Source	98	
VS5T026	26	8/2/2005			No Source	98	
VS5T026	26	8/2/2005	3rd Deck-2	Shielded IPA p	Flaming	20	10:43:00
VS5T026	26	8/2/2005	3rd Deck-2	Shielded IPA p	Flaming	20	10:43:00
VS5T026	26	8/2/2005	Ops-10	Torch Cutting	Nuisance	12	10:43:00
VS5T026	26	8/2/2005	Ops-10	Torch Cutting	Nuisance	12	10:43:00
VS5T027	27	8/2/2005			No Source	98	
VS5T027	27	8/2/2005			No Source	98	
VS5T027	27	8/2/2005	Ops-12	Pipe rupture –	Pipe Rupture	40	12:28:07
VS5T027	27	8/2/2005	Pway-14	Torch Cutting	Nuisance	12	12:28:00
VS5T027	27	8/2/2005			No Source	98	
VS5T027	27	8/2/2005	ES-18	Smoldering M	Smolder	30	12:28:00
VS5T027	27	8/2/2005			No Source	98	
VS5T027	27	8/2/2005			No Source	98	
VS5T027	27	8/2/2005	Ops-12	Pipe rupture –	Pipe Rupture	40	12:28:07
VS5T027	27	8/2/2005	Ops-12	Pipe rupture –	Pipe Rupture	40	12:28:07

VS5T028	28	8/2/2005			No Source	98	
VS5T028	28	8/2/2005	2nd Deck-8	Gas release-sm	Gas Release	60	13:36:00
VS5T028	28	8/2/2005	Ops-13	Smoldering Oi	Smolder	30	13:35:00
VS5T028	28	8/2/2005			No Source	98	
VS5T028	28	8/2/2005	PVLS-15	Smoldering Oi	Smolder	30	13:35:00
VS5T028	28	8/2/2005			No Source	98	
VS5T028	28	8/2/2005			No Source	98	
VS5T028	28	8/2/2005			No Source	98	
VS5T028	28	8/2/2005	Ops-13	Smoldering Oi	Smolder	30	13:35:00
VS5T028	28	8/2/2005	Ops-13	Smoldering Oi	Smolder	30	13:35:00
VS5T029	29	8/3/2005	3rd Deck-4	Pipe rupture - 1	Pipe Rupture	40	8:51:15
VS5T029	29	8/3/2005	2nd Deck-8	Smoldering Ca	Smolder	30	8:43:23
VS5T029	29	8/3/2005			No Source	98	
VS5T029	29	8/3/2005	Pway-20	Smoldering Ca	Smolder	30	8:41:00
VS5T029	29	8/3/2005			No Source	98	
VS5T029	29	8/3/2005	ES-17	Wall board abo	Flaming	20	8:41:03
VS5T029	29	8/3/2005	3rd Deck-4	Pipe rupture - 1	Pipe Rupture	40	8:51:15
VS5T029	29	8/3/2005	3rd Deck-4	Pipe rupture - 1	Pipe Rupture	40	8:51:15
VS5T029	29	8/3/2005			No Source	98	
VS5T029	29	8/3/2005			No Source	98	
VS5T030	30	8/3/2005			No Source	98	
VS5T030	30	8/3/2005	2nd Deck-9	SCBA	Gas Release	60	10:06:00
VS5T030	30	8/3/2005	Ops-11	Flaming Shipp	Flaming	20	10:05:00
VS5T030	30	8/3/2005			No Source	98	
VS5T030	30	8/3/2005			No Source	98	
VS5T030	30	8/3/2005	ES-17	Smoldering Ca	Smolder	30	10:05:00
VS5T030	30	8/3/2005			No Source	98	
VS5T030	30	8/3/2005			No Source	98	
VS5T030	30	8/3/2005	Ops-11	Flaming Shipp	Flaming	20	10:05:00
VS5T030	30	8/3/2005	Ops-11	Flaming Shipp	Flaming	20	10:05:00
VS5T031	31	8/3/2005	3rd Deck-5	Smoldering M	Smolder	30	11:08:00
VS5T031	31	8/3/2005			No Source	98	
VS5T031	31	8/3/2005			No Source	98	
VS5T031	31	8/3/2005			No Source	98	
VS5T031	31	8/3/2005	PVLS-19	Arc Welding	Nuisance	11	11:08:00
VS5T031	31	8/3/2005			No Source	98	
VS5T031	31	8/3/2005	3rd Deck-5	Smoldering M	Smolder	30	11:08:00
VS5T031	31	8/3/2005	3rd Deck-5	Smoldering M	Smolder	30	11:08:00
VS5T031	31	8/3/2005			No Source	98	
VS5T031	31	8/3/2005			No Source	98	
VS5T032	32	8/3/2005			No Source	98	
VS5T032	32	8/3/2005	2nd Deck-9	8 Flaming Car	Flaming	20	12:40:00

VS5T032	32	8/3/2005	Ops-13	Waving Mater	Nuisance	10	12:41:30
VS5T032	32	8/3/2005	Pway-20	Smoldering Oi	Smolder	32	12:40:00
VS5T032	32	8/3/2005			No Source	98	
VS5T032	32	8/3/2005			No Source	98	
VS5T032	32	8/3/2005			No Source	98	
VS5T032	32	8/3/2005			No Source	98	
VS5T032	32	8/3/2005	Ops-13	Waving Mater	Nuisance	10	12:41:30
VS5T032	32	8/3/2005	Ops-13	Waving Mater	Nuisance	10	12:41:30
VS5T033	33	8/3/2005	3rd Deck-6	Painted Bulkhe	Smolder	31	14:31:00
VS5T033	33	8/3/2005	2nd Deck-9	4 Flaming Car	Flaming	20	14:30:20
VS5T033	33	8/3/2005			No Source	98	
VS5T033	33	8/3/2005	Pway-14	Gas release-(A	Gas Release	60	14:30:20
VS5T033	33	8/3/2005			No Source	98	
VS5T033	33	8/3/2005			No Source	98	
VS5T033	33	8/3/2005	3rd Deck-6	Painted Bulkhe	Smolder	31	14:31:00
VS5T033	33	8/3/2005	3rd Deck-6	Painted Bulkhe	Smolder	31	14:31:00
VS5T033	33	8/3/2005			No Source	98	
VS5T033	33	8/3/2005			No Source	98	
VS5T034	34	8/4/2005	All spaces except PVLS	People workin	Nuisance	10	8:21:00
VS5T034	34	8/4/2005	All spaces except PVLS	People workin	Nuisance	10	8:21:00
VS5T034	34	8/4/2005	All spaces except PVLS	People workin	Nuisance	10	8:21:00
VS5T034	34	8/4/2005	All spaces except PVLS	People workin	Nuisance	10	8:21:00
VS5T034	34	8/4/2005			No Source	98	
VS5T034	34	8/4/2005	All spaces except PVLS	People workin	Nuisance	10	8:21:00
VS5T034	34	8/4/2005	All spaces except PVLS	People workin	Nuisance	10	8:21:00
VS5T034	34	8/4/2005	All spaces except PVLS	People workin	Nuisance	10	8:21:00
VS5T034	34	8/4/2005	All spaces except PVLS	People workin	Nuisance	10	8:21:00
VS5T034	34	8/4/2005	All spaces except PVLS	People workin	Nuisance	10	8:21:00
VS5T035	35	8/4/2005	3rd Deck-1	Space heater	Nuisance	15	9:34:00
VS5T035	35	8/4/2005	2nd Deck-9	43 kW Heptan	Flaming	20	9:39:00
VS5T035	35	8/4/2005	Ops-22	181 kW Hepta	Flaming	20	9:37:00
VS5T035	35	8/4/2005			No Source	98	
VS5T035	35	8/4/2005			No Source	98	

VS5T035	35	8/4/2005			No Source	98	
VS5T035	35	8/4/2005	3rd Deck-1	Space heater	Nuisance	15	9:34:00
VS5T035	35	8/4/2005	3rd Deck-1	Space heater	Nuisance	15	9:34:00
VS5T035	35	8/4/2005	Ops-22	181 kW Hepta	Flaming	20	9:37:00
VS5T035	35	8/4/2005	Ops-22	181 kW Hepta	Flaming	20	9:37:00
VS5T036	36	8/4/2005	3rd Deck-1	2 Flaming Car	Flaming	20	11:08:12
VS5T036	36	8/4/2005	2nd Deck-9	181 kW Hepta	Flaming	20	11:11:33
VS5T036	36	8/4/2005	Ops-22	43 kW Heptan	Flaming	20	11:10:02
VS5T036	36	8/4/2005			No Source	98	
VS5T036	36	8/4/2005	PVLS-15	Welding	Nuisance	11	11:08:00
VS5T036	36	8/4/2005			No Source	98	
VS5T036	36	8/4/2005	3rd Deck-1	2 Flaming Car	Flaming	20	11:08:12
VS5T036	36	8/4/2005	3rd Deck-1	2 Flaming Car	Flaming	20	11:08:12
VS5T036	36	8/4/2005	Ops-22	43 kW Heptan	Flaming	20	11:10:02
VS5T036	36	8/4/2005	Ops-22	43 kW Heptan	Flaming	20	11:10:02
VS5T037	37	8/4/2005	3rd Deck-4	2 Flaming Car	Flaming	20	12:36:13
VS5T037	37	8/4/2005	2nd Deck-9	13 kW Heptan	Flaming	20	12:40:00
VS5T037	37	8/4/2005	Ops-21	132 kW Hepta	Flaming	20	12:38:00
VS5T037	37	8/4/2005			No Source	98	
VS5T037	37	8/4/2005	PVLS-15	Torch Cutting	Nuisance	12	12:36:00
VS5T037	37	8/4/2005			No Source	98	
VS5T037	37	8/4/2005	3rd Deck-4	2 Flaming Car	Flaming	20	12:36:13
VS5T037	37	8/4/2005	3rd Deck-4	2 Flaming Car	Flaming	20	12:36:13
VS5T037	37	8/4/2005	Ops-21	132 kW Hepta	Flaming	20	12:38:00
VS5T037	37	8/4/2005	Ops-21	132 kW Hepta	Flaming	20	12:38:00
VS5T037	37	8/4/2005	3rd Deck-4	2 Flaming Car	Flaming	20	12:36:13
VS5T037	37	8/4/2005	2nd Deck-9	13 kW Heptan	Flaming	20	12:40:00
VS5T037	37	8/4/2005	Ops-21	132 kW Hepta	Flaming	20	12:38:00
VS5T037	37	8/4/2005			No Source	98	
VS5T037	37	8/4/2005	PVLS-15	Torch Cutting	Nuisance	12	12:36:00
VS5T037	37	8/4/2005			No Source	98	
VS5T038	38	8/4/2005	3rd Deck-4	Pipe rupture –	Pipe Rupture	40	13:32:35
VS5T038	38	8/4/2005	2nd Deck-9	132 kW Hepta	Flaming	20	13:32:00
VS5T038	38	8/4/2005	Ops-21	13 kW Heptan	Flaming	20	13:30:00
VS5T038	38	8/4/2005			No Source	98	
VS5T038	38	8/4/2005	PVLS-19	Grinding Paint	Nuisance	13	13:35:25
VS5T038	38	8/4/2005			No Source	98	
VS5T038	38	8/4/2005	3rd Deck-4	Pipe rupture –	Pipe Rupture	40	13:32:35
VS5T038	38	8/4/2005	3rd Deck-4	Pipe rupture –	Pipe Rupture	40	13:32:35
VS5T038	38	8/4/2005	Ops-21	13 kW Heptan	Flaming	20	13:30:00
VS5T038	38	8/4/2005	Ops-21	13 kW Heptan	Flaming	20	13:30:00

VS5T038	38	8/4/2005	3rd Deck-4	Pipe rupture –	Pipe Rupture	40	13:32:35
VS5T038	38	8/4/2005	2nd Deck-9	132 kW Hepta	Flaming	20	13:32:00
VS5T038	38	8/4/2005	Ops-21	13 kW Heptan	Flaming	20	13:30:00
VS5T038	38	8/4/2005			No Source	98	
VS5T038	38	8/4/2005	PVLS-19	Grinding Paint	Nuisance	13	13:35:25
VS5T038	38	8/4/2005			No Source	98	
VS5T039	39	8/4/2005	3rd Deck-6	Painted Bulkhe	Smolder/Flaming	31	14:26:00
VS5T039	39	8/4/2005			No Source	98	
VS5T039	39	8/4/2005	Ops-23	Radio	Nuisance	10	14:22:00
VS5T039	39	8/4/2005	Pway-14	Grinding Paint	Nuisance	13	14:26:30
VS5T039	39	8/4/2005			No Source	98	
VS5T039	39	8/4/2005			No Source	98	
VS5T039	39	8/4/2005	3rd Deck-6	Painted Bulkhe	Smolder/Flaming	31	14:26:00
VS5T039	39	8/4/2005	3rd Deck-6	Painted Bulkhe	Smolder/Flaming	31	14:26:00
VS5T039	39	8/4/2005	Ops-23	Radio	Nuisance	10	14:22:00
VS5T039	39	8/4/2005	Ops-23	Radio	Nuisance	10	14:22:00
VS5T039	39	8/4/2005	3rd Deck-6	Painted Bulkhe	Smolder/Flaming	31	14:26:00
VS5T039	39	8/4/2005			No Source	98	
VS5T039	39	8/4/2005	Ops-23	Radio	Nuisance	10	14:22:00
VS5T039	39	8/4/2005	Pway-14	Grinding Paint	Nuisance	13	14:26:30
VS5T039	39	8/4/2005			No Source	98	
VS5T039	39	8/4/2005			No Source	98	

NOTE: *FM2 locked up during Test #22 at time 13:36:56. No fusion machine data is available after that time.*
FM2 locked up during Test #39 at time 14:31:08. No fusion machine data is available after that time.

		Compartment Source #2				
Transition Time	Source Stop Time	Compartment - Location	Source Description	Source Type	Source Category	Source Start Time
	11:25:30			No Source	98	
	11:26:09			No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	11:25:30			No Source	98	
	11:25:30			No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	14:04:00	2nd Deck-8	Gas Release (Air	Gas Release	60	14:01:30
	14:00:38			No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	14:00:38			No Source	98	
	14:00:38			No Source	98	
				No Source	98	
	14:37:40			No Source	98	
	14:39:38	Ops-12	Water Aerosol -N	Pipe Rupture	40	14:40:30
				No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	14:39:38	Ops-12	Water Aerosol -N	Pipe Rupture	40	14:40:30
	14:39:38	Ops-12	Water Aerosol -N	Pipe Rupture	40	14:40:30
	9:38:30			No Source	98	
				No Source	98	

	9:33:25	Ops-13	Pipe rupture – G	Pipe Rupture	40	9:34:00
				No Source	98	
				No Source	98	
				No Source	98	
	9:38:30			No Source	98	
	9:38:30			No Source	98	
	9:33:25	Ops-13	Pipe rupture – G	Pipe Rupture	40	9:34:00
	9:33:25	Ops-13	Pipe rupture – G	Pipe Rupture	40	9:34:00
	10:43:10			No Source	98	
	10:55:05			No Source	98	
	10:54:12			No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	10:43:10			No Source	98	
	10:43:10			No Source	98	
	10:54:12			No Source	98	
	10:54:12			No Source	98	
	12:26:00			No Source	98	
				No Source	98	
12:18:00	12:21:15	Ops-13	Pipe rupture – Sp	Pipe Rupture	40	12:22:00
				No Source	98	
				No Source	98	
				No Source	98	
	12:26:00			No Source	98	
	12:26:00			No Source	98	
12:18:00	12:21:15	Ops-13	Pipe rupture – Sp	Pipe Rupture	40	12:22:00
12:18:00	12:21:15	Ops-13	Pipe rupture – Sp	Pipe Rupture	40	12:22:00
13:37:50	13:48:50	3rd Deck-5	Gas Leak	Gas Release	60	13:30:30
				No Source	98	
				No Source	98	
	13:28:30			No Source	98	
				No Source	98	
				No Source	98	
13:37:50	13:48:50	3rd Deck-5	Gas Leak	Gas Release	60	13:30:30
13:37:50	13:48:50	3rd Deck-5	Gas Leak	Gas Release	60	13:30:30
				No Source	98	
				No Source	98	
	14:34:00			No Source	98	

				No Source	98	
	14:33:00	Ops-11	Gas Release N2	Gas Release	60	14:28:30
				No Source	98	
				No Source	98	
				No Source	98	
	14:34:00			No Source	98	
	14:34:00			No Source	98	
	14:33:00	Ops-11	Gas Release N2	Gas Release	60	14:28:30
	14:33:00	Ops-11	Gas Release N2	Gas Release	60	14:28:30
	10:38:00	3rd Deck-5	SCBA	Gas Release	60	10:35:00
				No Source	98	
	10:33:38			No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	10:38:00	3rd Deck-5	SCBA	Gas Release	60	10:35:00
	10:38:00	3rd Deck-5	SCBA	Gas Release	60	10:35:00
	10:33:38			No Source	98	
	10:33:38			No Source	98	
	12:25:19			No Source	98	
				No Source	98	
	12:46:00	Ops-12	Smoldering Cabl	Fire Scenario	30	12:21:30
				No Source	98	
				No Source	98	
				No Source	98	
	12:25:19			No Source	98	
	12:25:19			No Source	98	
	12:46:00	Ops-12	Smoldering Cabl	Fire Scenario	30	12:21:30
	12:46:00	Ops-12	Smoldering Cabl	Fire Scenario	30	12:21:30
	13:59:04			No Source	98	
				No Source	98	
	13:57:00			No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	13:59:04			No Source	98	
	13:59:04			No Source	98	
	13:57:00			No Source	98	
	13:57:00			No Source	98	

				No Source	98	
	14:37:08	2nd Deck-7	Flaming Cardboa	Flaming	20	14:37:50
	14:49:00			No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	14:49:00			No Source	98	
	14:49:00			No Source	98	
				No Source	98	
	8:58:45			No Source	98	
	8:56:30	Ops-13	IPA spill fire	Flaming	20	9:00:34
				No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	8:56:30	Ops-13	IPA spill fire	Flaming	20	9:00:34
	8:56:30	Ops-13	IPA spill fire	Flaming	20	9:00:34
	9:42:05	3rd Deck-1	Smoldering Laur	Fire Scenario	30	9:42:00
				No Source	98	
				No Source	98	
	9:38:25			No Source	98	
				No Source	98	
				No Source	98	
	9:42:05	3rd Deck-1	Smoldering Laur	Fire Scenario	30	9:42:00
	9:42:05	3rd Deck-1	Smoldering Laur	Fire Scenario	30	9:42:00
				No Source	98	
				No Source	98	
				No Source	98	
	10:56:45			No Source	98	
	10:53:50	Ops-13	Smoldering Cabl	Smolder	30	10:54:10
				No Source	98	
				No Source	98	
	10:56:45			No Source	98	
				No Source	98	
				No Source	98	
	10:53:50	Ops-13	Smoldering Cabl	Smolder	30	10:54:10
	10:53:50	Ops-13	Smoldering Cabl	Smolder	30	10:54:10

				No Source	98	
	12:21:40	2nd Deck-8	Smoldering Matt	Smolder	30	12:21:53
				No Source	98	
				No Source	98	
	12:31:00			No Source	98	
	12:31:00			No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	13:42:00	3rd Deck-5	Smoldering Oily	Smolder	30	13:23:00
				No Source	98	
	13:27:20			No Source	98	
	13:28:55			No Source	98	
				No Source	98	
				No Source	98	
	13:42:00	3rd Deck-5	Smoldering Oily	Smolder	30	13:23:00
	13:42:00	3rd Deck-5	Smoldering Oily	Smolder	30	13:23:00
	13:27:20			No Source	98	
	13:27:20			No Source	98	
	14:33:40			No Source	98	
				No Source	98	
	14:25:30	Ops-13	Flaming Trash C	Flaming	20	14:26:30
	14:33:40			No Source	98	
				No Source	98	
				No Source	98	
	14:33:40			No Source	98	
	14:33:40			No Source	98	
	14:25:30	Ops-13	Flaming Trash C	Flaming	20	14:26:30
	14:25:30	Ops-13	Flaming Trash C	Flaming	20	14:26:30
	9:12:20			No Source	98	
	9:10:28	2nd Deck-9	Smoldering Cabl	Smolder	30	9:11:00
	9:11:30			No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	9:12:20			No Source	98	
	9:12:20			No Source	98	
	9:11:30			No Source	98	

	9:11:30			No Source	98	
	10:27:25	3rd Deck-4	Pipe Rupture – o	Pipe Rupture	40	10:29:13
	10:38:00	2nd Deck-7	IPA spill fire	Flaming	20	10:33:07
				No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	10:27:25	3rd Deck-4	Pipe Rupture – o	Pipe Rupture	40	10:29:13
	10:27:25	3rd Deck-4	Pipe Rupture – o	Pipe Rupture	40	10:29:13
				No Source	98	
				No Source	98	
	12:15:00			No Source	98	
	12:16:00	2nd Deck	Sprinkler/Mist S	Suppression System	70	12:19:09
	12:22:00			No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	12:15:00			No Source	98	
	12:15:00			No Source	98	
	12:22:00			No Source	98	
	12:22:00			No Source	98	
	13:13:38	3rd Deck-4	Pipe rupture – 10	Pipe Rupture	40	13:15:06
	13:10:10			No Source	98	
				No Source	98	
	13:40:30			No Source	98	
				No Source	98	
				No Source	98	
	13:13:38	3rd Deck-4	Pipe rupture – 10	Pipe Rupture	40	13:15:06
	13:13:38	3rd Deck-4	Pipe rupture – 10	Pipe Rupture	40	13:15:06
				No Source	98	
				No Source	98	
	14:40:40			No Source	98	
	14:41:00	2nd Deck-8	Gas release (N	Gas Release	60	14:42:30
	14:37:15			No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	14:40:40			No Source	98	
	14:40:40			No Source	98	

	14:37:15			No Source	98	
	14:37:15			No Source	98	
	8:44:40			No Source	98	
				No Source	98	
	8:45:23	Ops-12	Pipe rupture - 10	Pipe Rupture	40	8:46:08
	8:43:50			No Source	98	
				No Source	98	
				No Source	98	
	8:44:40			No Source	98	
	8:44:40			No Source	98	
	8:45:23	Ops-12	Pipe rupture - 10	Pipe Rupture	40	8:46:08
	8:45:23	Ops-12	Pipe rupture - 10	Pipe Rupture	40	8:46:08
	9:50:00			No Source	98	
				No Source	98	
	9:37:10	Ops-11	Gas release (N	Gas Release	60	9:39:00
				No Source	98	
	9:38:00			No Source	98	
				No Source	98	
	9:50:00	Ops-11	Gas release (N	Gas Release	60	9:39:00
	9:50:00	Ops-11	Gas release (N	Gas Release	60	9:39:00
	9:37:10			No Source	98	
	9:37:10			No Source	98	
	10:49:55			No Source	98	
				No Source	98	
	10:48:00	Ops-13	Gas release (N	Gas Release	60	10:49:00
	10:58:00			No Source	98	
				No Source	98	
				No Source	98	
	10:49:55			No Source	98	
	10:49:55			No Source	98	
	10:48:00	Ops-13	Gas release (N	Gas Release	60	10:49:00
	10:48:00	Ops-13	Gas release (N	Gas Release	60	10:49:00
				No Source	98	
				No Source	98	
	12:30:03	Ops-13	Shielded IPA par	Flaming	20	12:33:06
	12:34:00			No Source	98	
				No Source	98	
	12:41:30			No Source	98	
				No Source	98	
				No Source	98	
	12:30:03	Ops-13	Shielded IPA par	Flaming	20	12:33:06
	12:30:03	Ops-13	Shielded IPA par	Flaming	20	12:33:06

				No Source	98	
	13:37:50	2nd Deck-9	2 Smoldering Bo	Smolder	30	13:39:00
	13:49:07			No Source	98	
				No Source	98	
	13:53:00			No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	13:49:07			No Source	98	
	13:49:07			No Source	98	
	8:52:20			No Source	98	
	9:03:00			No Source	98	
				No Source	98	
	9:03:00			No Source	98	
				No Source	98	
	8:49:50			No Source	98	
	8:52:20			No Source	98	
	8:52:20			No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	10:07:10	2nd Deck-7	2 Flaming Boxes	Flaming	20	10:08:00
	10:21:40			No Source	98	
				No Source	98	
				No Source	98	
	10:22:30			No Source	98	
				No Source	98	
				No Source	98	
	10:21:40			No Source	98	
	10:21:40			No Source	98	
	11:29:00	3rd Deck-3	Gas release-(Air	Gas Release	60	11:09:00
				No Source	98	
				No Source	98	
				No Source	98	
	11:15:20			No Source	98	
				No Source	98	
	11:29:00	3rd Deck-3	Gas release-(Air	Gas Release	60	11:09:00
	11:29:00	3rd Deck-3	Gas release-(Air	Gas Release	60	11:09:00
				No Source	98	
				No Source	98	
				No Source	98	
	12:47:17			No Source	98	

	12:43:47			No Source	98	
12:54:23	12:57:48			No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
				No Source	98	
	12:43:47			No Source	98	
	12:43:47			No Source	98	
	14:40:35			No Source	98	
	14:33:52	2nd Deck-8	Sprinkler/Mist S	Suppression System	70	14:33:52
				No Source	98	
	14:33:10	Pway-20	Flaming Shippin	Flaming	20	14:33:30
	No Source			No Source	98	
	No Source			No Source	98	
	14:40:35			No Source	98	
	14:40:35			No Source	98	
	No Source			No Source	98	
	No Source			No Source	98	
	9:05:00			No Source	98	
	9:05:00			No Source	98	
	9:05:00			No Source	98	
	9:05:00			No Source	98	
				No Source	98	
	9:05:00			No Source	98	
	9:05:00			No Source	98	
	9:05:00			No Source	98	
	9:05:00			No Source	98	
	9:05:00			No Source	98	
	10:20:00	3rd Deck-21	Smoldering Oily	Smolder	30	9:35:00
	9:44:50			No Source	98	
	9:41:55			No Source	98	
				No Source	98	
				No Source	98	

				No Source	98	
	10:20:00	3rd Deck-21	Smoldering Oily	Smolder	30	9:35:00
	10:20:00	3rd Deck-21	Smoldering Oily	Smolder	30	9:35:00
	9:41:55			No Source	98	
	9:41:55			No Source	98	
	11:14:55			No Source	98	
	11:16:03			No Source	98	
	11:14:30			No Source	98	
				No Source	98	
	11:13:50			No Source	98	
				No Source	98	
	11:14:55			No Source	98	
	11:14:55			No Source	98	
	11:14:30			No Source	98	
	11:14:30			No Source	98	
	12:48:13			No Source	98	
	12:49:20			No Source	98	
	12:42:11			No Source	98	
				No Source	98	
	12:40:09			No Source	98	
				No Source	98	
	12:48:13			No Source	98	
	12:48:13			No Source	98	
	12:42:11			No Source	98	
	12:42:11			No Source	98	
	12:48:13			No Source	98	
	12:49:20			No Source	98	
	12:42:11			No Source	98	
				No Source	98	
	12:40:09			No Source	98	
				No Source	98	
	13:34:50			No Source	98	
	13:35:50			No Source	98	
	13:35:11			No Source	98	
				No Source	98	
	13:38:30			No Source	98	
				No Source	98	
	13:34:50			No Source	98	
	13:34:50			No Source	98	
	13:35:11			No Source	98	
	13:35:11			No Source	98	

	13:34:50			No Source	98	
	13:35:50			No Source	98	
	13:35:11			No Source	98	
				No Source	98	
	13:38:30			No Source	98	
				No Source	98	
	14:33:22			No Source	98	
				No Source	98	
	14:36:00	Ops-11	Flaming Trash C	Flaming	20	14:30:45
	14:30:00			No Source	98	
				No Source	98	
				No Source	98	
	14:33:22			No Source	98	
	14:33:22			No Source	98	
	14:36:00	Ops-11	Flaming Trash C	Flaming	20	14:30:45
	14:36:00	Ops-11	Flaming Trash C	Flaming	20	14:30:45
	14:33:22			No Source	98	
				No Source	98	
	14:36:00	Ops-11	Flaming Trash C	Flaming	20	14:30:45
	14:30:00			No Source	98	
				No Source	98	
				No Source	98	

Fusion Machine 2
CVID = AxonX's Signifire

Transition Time	Source Stop Time	FM Type	DF Object Number	Compartment / ID String	CnC Date	CnC Start Time	CnC Stop Time
		FM2	0	3MAG	7/26/2005	11:12:03	11:28:03
		FM2	1	2MAG	7/26/2005	11:12:03	11:28:03
		FM2	2	2OPS	7/26/2005	11:12:03	11:28:03
		FM2	3	2PAS	7/26/2005	11:12:03	11:28:03
		FM2	4	PVLS	7/26/2005	11:12:03	11:28:03
		FM2	5	3ES	7/26/2005	11:12:03	11:28:03
		FM2	6	3MAG-SS#2	7/26/2005	11:12:03	11:28:03
		FM2	7	3MAG-SS#3	7/26/2005	11:12:03	11:28:03
		FM2	8	2OPS-SS#5	7/26/2005	11:12:03	11:28:03
		FM2	9	2OPS-SS#6	7/26/2005	11:12:03	11:28:03
		FM2	0	3MAG	7/26/2005	13:49:04	14:04:04
	14:02:35	FM2	1	2MAG	7/26/2005	13:49:04	14:04:04
		FM2	2	2OPS	7/26/2005	13:49:04	14:04:04
		FM2	3	2PAS	7/26/2005	13:49:04	14:04:04
		FM2	4	PVLS	7/26/2005	13:49:04	14:04:04
		FM2	5	3ES	7/26/2005	13:49:04	14:04:04
		FM2	6	3MAG-SS#2	7/26/2005	13:49:04	14:04:04
		FM2	7	3MAG-SS#3	7/26/2005	13:49:04	14:04:04
		FM2	8	2OPS-SS#5	7/26/2005	13:49:04	14:04:04
		FM2	9	2OPS-SS#6	7/26/2005	13:49:04	14:04:04
		FM2	0	3MAG	7/26/2005	14:31:32	14:46:05
		FM2	1	2MAG	7/26/2005	14:31:32	14:46:05
	14:46:00	FM2	2	2OPS	7/26/2005	14:31:32	14:46:05
		FM2	3	2PAS	7/26/2005	14:31:32	14:46:05
		FM2	4	PVLS	7/26/2005	14:31:32	14:46:05
		FM2	5	3ES	7/26/2005	14:31:32	14:46:05
		FM2	6	3MAG-SS#2	7/26/2005	14:31:32	14:46:05
		FM2	7	3MAG-SS#3	7/26/2005	14:31:32	14:46:05
	14:46:00	FM2	8	2OPS-SS#5	7/26/2005	14:31:32	14:46:05
	14:46:00	FM2	9	2OPS-SS#6	7/26/2005	14:31:32	14:46:05
		FM2	0	3MAG	7/27/2005	9:21:59	9:38:30
		FM2	1	2MAG	7/27/2005	9:21:59	9:38:30

	9:36:48	FM2	2	2OPS	7/27/2005	9:21:59	9:38:30
		FM2	3	2PAS	7/27/2005	9:21:59	9:38:30
		FM2	4	PVLS	7/27/2005	9:21:59	9:38:30
		FM2	5	3ES	7/27/2005	9:21:59	9:38:30
		FM2	6	3MAG-SS#2	7/27/2005	9:21:59	9:38:30
		FM2	7	3MAG-SS#3	7/27/2005	9:21:59	9:38:30
	9:36:48	FM2	8	2OPS-SS#5	7/27/2005	9:21:59	9:38:30
	9:36:48	FM2	9	2OPS-SS#6	7/27/2005	9:21:59	9:38:30
		FM2	0	3MAG	7/27/2005	10:35:59	10:55:30
		FM2	1	2MAG	7/27/2005	10:35:59	10:55:30
		FM2	2	2OPS	7/27/2005	10:35:59	10:55:30
		FM2	3	2PAS	7/27/2005	10:35:59	10:55:30
		FM2	4	PVLS	7/27/2005	10:35:59	10:55:30
		FM2	5	3ES	7/27/2005	10:35:59	10:55:30
		FM2	6	3MAG-SS#2	7/27/2005	10:35:59	10:55:30
		FM2	7	3MAG-SS#3	7/27/2005	10:35:59	10:55:30
		FM2	8	2OPS-SS#5	7/27/2005	10:35:59	10:55:30
		FM2	9	2OPS-SS#6	7/27/2005	10:35:59	10:55:30
		FM2	0	3MAG	7/27/2005	12:05:58	12:25:59
		FM2	1	2MAG	7/27/2005	12:05:58	12:25:59
	12:24:00	FM2	2	2OPS	7/27/2005	12:05:58	12:25:59
		FM2	3	2PAS	7/27/2005	12:05:58	12:25:59
		FM2	4	PVLS	7/27/2005	12:05:58	12:25:59
		FM2	5	3ES	7/27/2005	12:05:58	12:25:59
		FM2	6	3MAG-SS#2	7/27/2005	12:05:58	12:25:59
		FM2	7	3MAG-SS#3	7/27/2005	12:05:58	12:25:59
	12:24:00	FM2	8	2OPS-SS#5	7/27/2005	12:05:58	12:25:59
	12:24:00	FM2	9	2OPS-SS#6	7/27/2005	12:05:58	12:25:59
	13:32:30	FM2	0	3MAG	7/27/2005	13:06:59	13:49:12
		FM2	1	2MAG	7/27/2005	13:06:59	13:49:12
		FM2	2	2OPS	7/27/2005	13:06:59	13:49:12
		FM2	3	2PAS	7/27/2005	13:06:59	13:49:12
		FM2	4	PVLS	7/27/2005	13:06:59	13:49:12
		FM2	5	3ES	7/27/2005	13:06:59	13:49:12
	13:32:30	FM2	6	3MAG-SS#2	7/27/2005	13:06:59	13:49:12
	13:32:30	FM2	7	3MAG-SS#3	7/27/2005	13:06:59	13:49:12
		FM2	8	2OPS-SS#5	7/27/2005	13:06:59	13:49:12
		FM2	9	2OPS-SS#6	7/27/2005	13:06:59	13:49:12
		FM2	0	3MAG	7/27/2005	14:16:59	14:33:58

		FM2	1	2MAG	7/27/2005	14:16:59	14:33:58
	14:32:35	FM2	2	2OPS	7/27/2005	14:16:59	14:33:58
		FM2	3	2PAS	7/27/2005	14:16:59	14:33:58
		FM2	4	PVLS	7/27/2005	14:16:59	14:33:58
		FM2	5	3ES	7/27/2005	14:16:59	14:33:58
		FM2	6	3MAG-SS#2	7/27/2005	14:16:59	14:33:58
		FM2	7	3MAG-SS#3	7/27/2005	14:16:59	14:33:58
	14:32:35	FM2	8	2OPS-SS#5	7/27/2005	14:16:59	14:33:58
	14:32:35	FM2	9	2OPS-SS#6	7/27/2005	14:16:59	14:33:58
	10:36:15	FM2	0	3MAG	7/28/2005	10:20:59	10:37:30
		FM2	1	2MAG	7/28/2005	10:20:59	10:37:30
		FM2	2	2OPS	7/28/2005	10:20:59	10:37:30
		FM2	3	2PAS	7/28/2005	10:20:59	10:37:30
		FM2	4	PVLS	7/28/2005	10:20:59	10:37:30
		FM2	5	3ES	7/28/2005	10:20:59	10:37:30
	10:36:15	FM2	6	3MAG-SS#2	7/28/2005	10:20:59	10:37:30
	10:36:15	FM2	7	3MAG-SS#3	7/28/2005	10:20:59	10:37:30
		FM2	8	2OPS-SS#5	7/28/2005	10:20:59	10:37:30
		FM2	9	2OPS-SS#6	7/28/2005	10:20:59	10:37:30
		FM2	0	3MAG	7/28/2005	11:52:59	12:46:00
		FM2	1	2MAG	7/28/2005	11:52:59	12:46:00
	12:46:00	FM2	2	2OPS	7/28/2005	11:52:59	12:46:00
		FM2	3	2PAS	7/28/2005	11:52:59	12:46:00
		FM2	4	PVLS	7/28/2005	11:52:59	12:46:00
		FM2	5	3ES	7/28/2005	11:52:59	12:46:00
		FM2	6	3MAG-SS#2	7/28/2005	11:52:59	12:46:00
		FM2	7	3MAG-SS#3	7/28/2005	11:52:59	12:46:00
	12:46:00	FM2	8	2OPS-SS#5	7/28/2005	11:52:59	12:46:00
	12:46:00	FM2	9	2OPS-SS#6	7/28/2005	11:52:59	12:46:00
		FM2	0	3MAG	7/28/2005	13:49:00	14:01:59
		FM2	1	2MAG	7/28/2005	13:49:00	14:01:59
		FM2	2	2OPS	7/28/2005	13:49:00	14:01:59
		FM2	3	2PAS	7/28/2005	13:49:00	14:01:59
		FM2	4	PVLS	7/28/2005	13:49:00	14:01:59
		FM2	5	3ES	7/28/2005	13:49:00	14:01:59
		FM2	6	3MAG-SS#2	7/28/2005	13:49:00	14:01:59
		FM2	7	3MAG-SS#3	7/28/2005	13:49:00	14:01:59
		FM2	8	2OPS-SS#5	7/28/2005	13:49:00	14:01:59
		FM2	9	2OPS-SS#6	7/28/2005	13:49:00	14:01:59

		FM2	0	3MAG	7/28/2005	14:26:59	14:48:59
	14:42:05	FM2	1	2MAG	7/28/2005	14:26:59	14:48:59
		FM2	2	2OPS	7/28/2005	14:26:59	14:48:59
		FM2	3	2PAS	7/28/2005	14:26:59	14:48:59
		FM2	4	PVLS	7/28/2005	14:26:59	14:48:59
		FM2	5	3ES	7/28/2005	14:26:59	14:48:59
		FM2	6	3MAG-SS#2	7/28/2005	14:26:59	14:48:59
		FM2	7	3MAG-SS#3	7/28/2005	14:26:59	14:48:59
		FM2	8	2OPS-SS#5	7/28/2005	14:26:59	14:48:59
		FM2	9	2OPS-SS#6	7/28/2005	14:26:59	14:48:59
		FM2	0	3MAG	7/29/2005	8:44:59	9:02:31
		FM2	1	2MAG	7/29/2005	8:44:59	9:02:31
	9:02:30	FM2	2	2OPS	7/29/2005	8:44:59	9:02:31
		FM2	3	2PAS	7/29/2005	8:44:59	9:02:31
		FM2	4	PVLS	7/29/2005	8:44:59	9:02:31
		FM2	5	3ES	7/29/2005	8:44:59	9:02:31
		FM2	6	3MAG-SS#2	7/29/2005	8:44:59	9:02:31
		FM2	7	3MAG-SS#3	7/29/2005	8:44:59	9:02:31
	9:02:30	FM2	8	2OPS-SS#5	7/29/2005	8:44:59	9:02:31
	9:02:30	FM2	9	2OPS-SS#6	7/29/2005	8:44:59	9:02:31
	9:55:00	FM2	0	3MAG	7/29/2005	9:30:00	9:55:00
		FM2	1	2MAG	7/29/2005	9:30:00	9:55:01
		FM2	2	2OPS	7/29/2005	9:30:00	9:55:01
		FM2	3	2PAS	7/29/2005	9:30:00	9:55:01
		FM2	4	PVLS	7/29/2005	9:30:00	9:55:01
		FM2	5	3ES	7/29/2005	9:30:00	9:55:01
	9:55:00	FM2	6	3MAG-SS#2	7/29/2005	9:30:00	9:55:01
	9:55:00	FM2	7	3MAG-SS#3	7/29/2005	9:30:00	9:55:01
		FM2	8	2OPS-SS#5	7/29/2005	9:30:00	9:55:01
		FM2	9	2OPS-SS#6	7/29/2005	9:30:00	9:55:01
		FM2	0	3MAG	7/29/2005	10:43:00	11:10:01
		FM2	1	2MAG	7/29/2005	10:43:00	11:10:01
	11:10:05	FM2	2	2OPS	7/29/2005	10:43:00	11:10:01
		FM2	3	2PAS	7/29/2005	10:43:00	11:10:01
		FM2	4	PVLS	7/29/2005	10:43:00	11:10:01
		FM2	5	3ES	7/29/2005	10:43:00	11:10:01
		FM2	6	3MAG-SS#2	7/29/2005	10:43:00	11:10:01
		FM2	7	3MAG-SS#3	7/29/2005	10:43:00	11:10:01
	11:10:05	FM2	8	2OPS-SS#5	7/29/2005	10:43:00	11:10:01
	11:10:05	FM2	9	2OPS-SS#6	7/29/2005	10:43:00	11:10:01

		FM2	0	3MAG	7/29/2005	12:11:59	12:31:00
	12:27:50	FM2	1	2MAG	7/29/2005	12:11:59	12:31:00
		FM2	2	2OPS	7/29/2005	12:11:59	12:31:00
		FM2	3	2PAS	7/29/2005	12:11:59	12:31:00
		FM2	4	PVLS	7/29/2005	12:11:59	12:31:00
		FM2	5	3ES	7/29/2005	12:11:59	12:31:00
		FM2	6	3MAG-SS#2	7/29/2005	12:11:59	12:31:00
		FM2	7	3MAG-SS#3	7/29/2005	12:11:59	12:31:00
		FM2	8	2OPS-SS#5	7/29/2005	12:11:59	12:31:00
		FM2	9	2OPS-SS#6	7/29/2005	12:11:59	12:31:00
	13:42:00	FM2	0	3MAG	7/29/2005	13:10:59	13:41:59
		FM2	1	2MAG	7/29/2005	13:10:59	13:41:59
		FM2	2	2OPS	7/29/2005	13:10:59	13:41:59
		FM2	3	2PAS	7/29/2005	13:10:59	13:41:59
		FM2	4	PVLS	7/29/2005	13:10:59	13:41:59
		FM2	5	3ES	7/29/2005	13:10:59	13:41:59
	13:42:00	FM2	6	3MAG-SS#2	7/29/2005	13:10:59	13:41:59
	13:42:00	FM2	7	3MAG-SS#3	7/29/2005	13:10:59	13:41:59
		FM2	8	2OPS-SS#5	7/29/2005	13:10:59	13:41:59
		FM2	9	2OPS-SS#6	7/29/2005	13:10:59	13:41:59
		FM2	0	3MAG	7/29/2005	14:13:59	14:33:39
		FM2	1	2MAG	7/29/2005	14:13:59	14:33:39
	14:33:40	FM2	2	2OPS	7/29/2005	14:13:59	14:33:39
		FM2	3	2PAS	7/29/2005	14:13:59	14:33:39
		FM2	4	PVLS	7/29/2005	14:13:59	14:33:39
		FM2	5	3ES	7/29/2005	14:13:59	14:33:39
		FM2	6	3MAG-SS#2	7/29/2005	14:13:59	14:33:39
		FM2	7	3MAG-SS#3	7/29/2005	14:13:59	14:33:39
	14:33:40	FM2	8	2OPS-SS#5	7/29/2005	14:13:59	14:33:39
	14:33:40	FM2	9	2OPS-SS#6	7/29/2005	14:13:59	14:33:39
		FM2	0	3MAG	8/1/2005	9:03:01	9:48:01
	9:47:10	FM2	1	2MAG	8/1/2005	9:03:01	9:48:01
		FM2	2	2OPS	8/1/2005	9:03:01	9:48:01
		FM2	3	2PAS	8/1/2005	9:03:01	9:48:01
		FM2	4	PVLS	8/1/2005	9:03:01	9:48:01
		FM2	5	3ES	8/1/2005	9:03:01	9:48:01
		FM2	6	3MAG-SS#2	8/1/2005	9:03:01	9:48:01
		FM2	7	3MAG-SS#3	8/1/2005	9:03:01	9:48:01
		FM2	8	2OPS-SS#5	8/1/2005	9:03:01	9:48:01

		FM2	9	2OPS-SS#6	8/1/2005	9:03:01	9:48:01
	10:30:13	FM2	0	3MAG	8/1/2005	10:20:00	10:38:00
	10:38:00	FM2	1	2MAG	8/1/2005	10:20:00	10:38:00
		FM2	2	2OPS	8/1/2005	10:20:00	10:38:00
		FM2	3	2PAS	8/1/2005	10:20:00	10:38:00
		FM2	4	PVLS	8/1/2005	10:20:00	10:38:00
		FM2	5	3ES	8/1/2005	10:20:00	10:38:00
	10:30:13	FM2	6	3MAG-SS#2	8/1/2005	10:20:00	10:38:00
	10:30:13	FM2	7	3MAG-SS#3	8/1/2005	10:20:00	10:38:00
		FM2	8	2OPS-SS#5	8/1/2005	10:20:00	10:38:00
		FM2	9	2OPS-SS#6	8/1/2005	10:20:00	10:38:00
		FM2	0	3MAG	8/1/2005	12:03:00	12:22:01
	12:20:55	FM2	1	2MAG	8/1/2005	12:03:00	12:22:01
		FM2	2	2OPS	8/1/2005	12:03:00	12:22:01
		FM2	3	2PAS	8/1/2005	12:03:00	12:22:01
		FM2	4	PVLS	8/1/2005	12:03:00	12:22:01
		FM2	5	3ES	8/1/2005	12:03:00	12:22:01
		FM2	6	3MAG-SS#2	8/1/2005	12:03:00	12:22:01
		FM2	7	3MAG-SS#3	8/1/2005	12:03:00	12:22:01
		FM2	8	2OPS-SS#5	8/1/2005	12:03:00	12:22:01
		FM2	9	2OPS-SS#6	8/1/2005	12:03:00	12:22:01
	13:16:25	FM2	0	3MAG	8/1/2005	13:03:00	0
		FM2	1	2MAG	8/1/2005	13:03:00	0
		FM2	2	2OPS	8/1/2005	13:03:00	0
		FM2	3	2PAS	8/1/2005	13:03:00	0
		FM2	4	PVLS	8/1/2005	13:03:00	0
		FM2	5	3ES	8/1/2005	13:03:00	0
	13:16:25	FM2	6	3MAG-SS#2	8/1/2005	13:03:00	0
	13:16:25	FM2	7	3MAG-SS#3	8/1/2005	13:03:00	0
		FM2	8	2OPS-SS#5	8/1/2005	13:03:00	0
		FM2	9	2OPS-SS#6	8/1/2005	13:03:00	0
		FM2	0	3MAG	8/1/2005	14:30:00	14:43:59
	14:43:15	FM2	1	2MAG	8/1/2005	14:30:00	14:43:59
		FM2	2	2OPS	8/1/2005	14:30:00	14:43:59
		FM2	3	2PAS	8/1/2005	14:30:00	14:43:59
		FM2	4	PVLS	8/1/2005	14:30:00	14:43:59
		FM2	5	3ES	8/1/2005	14:30:00	14:43:59
		FM2	6	3MAG-SS#2	8/1/2005	14:30:00	14:43:59
		FM2	7	3MAG-SS#3	8/1/2005	14:30:00	14:43:59

		FM2	8	2OPS-SS#5	8/1/2005	14:30:00	14:43:59
		FM2	9	2OPS-SS#6	8/1/2005	14:30:00	14:43:59
		FM2	0	3MAG	8/2/2005	8:38:00	8:48:30
		FM2	1	2MAG	8/2/2005	8:38:00	8:48:30
	8:47:56	FM2	2	2OPS	8/2/2005	8:38:00	8:48:30
		FM2	3	2PAS	8/2/2005	8:38:00	8:48:30
		FM2	4	PVLS	8/2/2005	8:38:00	8:48:30
		FM2	5	3ES	8/2/2005	8:38:00	8:48:30
		FM2	6	3MAG-SS#2	8/2/2005	8:38:00	8:48:30
		FM2	7	3MAG-SS#3	8/2/2005	8:38:00	8:48:30
	8:47:56	FM2	8	2OPS-SS#5	8/2/2005	8:38:00	8:48:30
	8:47:56	FM2	9	2OPS-SS#6	8/2/2005	8:38:00	8:48:30
		FM2	0	3MAG	8/2/2005	9:31:00	9:50:01
		FM2	1	2MAG	8/2/2005	9:31:00	9:50:01
	9:40:35	FM2	2	2OPS	8/2/2005	9:31:00	9:50:01
		FM2	3	2PAS	8/2/2005	9:31:00	9:50:01
		FM2	4	PVLS	8/2/2005	9:31:00	9:50:01
		FM2	5	3ES	8/2/2005	9:31:00	9:50:01
	9:40:35	FM2	6	3MAG-SS#2	8/2/2005	9:31:00	9:50:01
	9:40:35	FM2	7	3MAG-SS#3	8/2/2005	9:31:00	9:50:01
		FM2	8	2OPS-SS#5	8/2/2005	9:31:00	9:50:01
		FM2	9	2OPS-SS#6	8/2/2005	9:31:00	9:50:01
		FM2	0	3MAG	8/2/2005	10:38:00	10:58:01
		FM2	1	2MAG	8/2/2005	10:38:00	10:58:01
	10:50:34	FM2	2	2OPS	8/2/2005	10:38:00	10:58:01
		FM2	3	2PAS	8/2/2005	10:38:00	10:58:01
		FM2	4	PVLS	8/2/2005	10:38:00	10:58:01
		FM2	5	3ES	8/2/2005	10:38:00	10:58:01
		FM2	6	3MAG-SS#2	8/2/2005	10:38:00	10:58:01
		FM2	7	3MAG-SS#3	8/2/2005	10:38:00	10:58:01
	10:50:34	FM2	8	2OPS-SS#5	8/2/2005	10:38:00	10:58:01
	10:50:34	FM2	9	2OPS-SS#6	8/2/2005	10:38:00	10:58:01
		FM2	0	3MAG	8/2/2005	12:22:59	12:45:29
		FM2	1	2MAG	8/2/2005	12:22:59	12:45:29
	12:44:34	FM2	2	2OPS	8/2/2005	12:22:59	12:45:29
		FM2	3	2PAS	8/2/2005	12:22:59	12:45:29
		FM2	4	PVLS	8/2/2005	12:22:59	12:45:29
		FM2	5	3ES	8/2/2005	12:22:59	12:45:29
		FM2	6	3MAG-SS#2	8/2/2005	12:22:59	12:45:29
		FM2	7	3MAG-SS#3	8/2/2005	12:22:59	12:45:29
	12:44:34	FM2	8	2OPS-SS#5	8/2/2005	12:22:59	12:45:29
	12:44:34	FM2	9	2OPS-SS#6	8/2/2005	12:22:59	12:45:29

		FM2	0	3MAG	8/2/2005	13:30:00	13:54:30
	13:50:40	FM2	1	2MAG	8/2/2005	13:30:00	13:54:30
		FM2	2	2OPS	8/2/2005	13:30:00	13:54:30
		FM2	3	2PAS	8/2/2005	13:30:00	13:54:30
		FM2	4	PVLS	8/2/2005	13:30:00	13:54:30
		FM2	5	3ES	8/2/2005	13:30:00	13:54:30
		FM2	6	3MAG-SS#2	8/2/2005	13:30:00	13:54:30
		FM2	7	3MAG-SS#3	8/2/2005	13:30:00	13:54:30
		FM2	8	2OPS-SS#5	8/2/2005	13:30:00	13:54:30
		FM2	9	2OPS-SS#6	8/2/2005	13:30:00	13:54:30
		FM2	0	3MAG	8/3/2005	8:36:01	9:03:00
		FM2	1	2MAG	8/3/2005	8:36:01	9:03:00
		FM2	2	2OPS	8/3/2005	8:36:01	9:03:00
		FM2	3	2PAS	8/3/2005	8:36:01	9:03:00
		FM2	4	PVLS	8/3/2005	8:36:01	9:03:00
		FM2	5	3ES	8/3/2005	8:36:01	9:03:00
		FM2	6	3MAG-SS#2	8/3/2005	8:36:01	9:03:00
		FM2	7	3MAG-SS#3	8/3/2005	8:36:01	9:03:00
		FM2	8	2OPS-SS#5	8/3/2005	8:36:01	9:03:00
		FM2	9	2OPS-SS#6	8/3/2005	8:36:01	9:03:00
		FM2	0	3MAG	8/3/2005	10:00:01	10:22:31
	10:13:30	FM2	1	2MAG	8/3/2005	10:00:01	10:22:31
		FM2	2	2OPS	8/3/2005	10:00:01	10:22:31
		FM2	3	2PAS	8/3/2005	10:00:01	10:22:31
		FM2	4	PVLS	8/3/2005	10:00:01	10:22:31
		FM2	5	3ES	8/3/2005	10:00:01	10:22:31
		FM2	6	3MAG-SS#2	8/3/2005	10:00:01	10:22:31
		FM2	7	3MAG-SS#3	8/3/2005	10:00:01	10:22:31
		FM2	8	2OPS-SS#5	8/3/2005	10:00:01	10:22:31
		FM2	9	2OPS-SS#6	8/3/2005	10:00:01	10:22:31
	11:10:45	FM2	0	3MAG	8/3/2005	11:03:00	11:29:01
		FM2	1	2MAG	8/3/2005	11:03:00	11:29:01
		FM2	2	2OPS	8/3/2005	11:03:00	11:29:01
		FM2	3	2PAS	8/3/2005	11:03:00	11:29:01
		FM2	4	PVLS	8/3/2005	11:03:00	11:29:01
		FM2	5	3ES	8/3/2005	11:03:00	11:29:01
	11:10:45	FM2	6	3MAG-SS#2	8/3/2005	11:03:00	11:29:01
	11:10:45	FM2	7	3MAG-SS#3	8/3/2005	11:03:00	11:29:01
		FM2	8	2OPS-SS#5	8/3/2005	11:03:00	11:29:01
		FM2	9	2OPS-SS#6	8/3/2005	11:03:00	11:29:01
		FM2	0	3MAG	8/3/2005	12:35:00	12:58:30
		FM2	1	2MAG	8/3/2005	12:35:00	12:58:30

		FM2	2	2OPS	8/3/2005	12:35:00	12:58:30
		FM2	3	2PAS	8/3/2005	12:35:00	12:58:30
		FM2	4	PVLS	8/3/2005	12:35:00	12:58:30
		FM2	5	3ES	8/3/2005	12:35:00	12:58:30
		FM2	6	3MAG-SS#2	8/3/2005	12:35:00	12:58:30
		FM2	7	3MAG-SS#3	8/3/2005	12:35:00	12:58:30
		FM2	8	2OPS-SS#5	8/3/2005	12:35:00	12:58:30
		FM2	9	2OPS-SS#6	8/3/2005	12:35:00	12:58:30
		FM2	0	3MAG	8/3/2005	14:25:01	14:50:29
	14:35:47	FM2	1	2MAG	8/3/2005	14:25:01	14:50:29
		FM2	2	2OPS	8/3/2005	14:25:01	14:50:29
	14:50:30	FM2	3	2PAS	8/3/2005	14:25:01	14:50:29
		FM2	4	PVLS	8/3/2005	14:25:01	14:50:29
		FM2	5	3ES	8/3/2005	14:25:01	14:50:29
		FM2	6	3MAG-SS#2	8/3/2005	14:25:01	14:50:29
		FM2	7	3MAG-SS#3	8/3/2005	14:25:01	14:50:29
		FM2	8	2OPS-SS#5	8/3/2005	14:25:01	14:50:29
		FM2	9	2OPS-SS#6	8/3/2005	14:25:01	14:50:29
		FM2	0	3MAG	8/4/2005	8:16:01	9:05:01
		FM2	1	2MAG	8/4/2005	8:16:01	9:05:01
		FM2	2	2OPS	8/4/2005	8:16:01	9:05:01
		FM2	3	2PAS	8/4/2005	8:16:01	9:05:01
		FM2	4	PVLS	8/4/2005	8:16:01	9:05:01
		FM2	5	3ES	8/4/2005	8:16:01	9:05:01
		FM2	6	3MAG-SS#2	8/4/2005	8:16:01	9:05:01
		FM2	7	3MAG-SS#3	8/4/2005	8:16:01	9:05:01
		FM2	8	2OPS-SS#5	8/4/2005	8:16:01	9:05:01
		FM2	9	2OPS-SS#6	8/4/2005	8:16:01	9:05:01
	10:20:00	FM2	0	3MAG	8/4/2005	9:29:01	10:20:01
		FM2	1	2MAG	8/4/2005	9:29:01	10:20:01
		FM2	2	2OPS	8/4/2005	9:29:01	10:20:01
		FM2	3	2PAS	8/4/2005	9:29:01	10:20:01
		FM2	4	PVLS	8/4/2005	9:29:01	10:20:01

		FM2	5	3ES	8/4/2005	9:29:01	10:20:01
	10:20:00	FM2	6	3MAG-SS#2	8/4/2005	9:29:01	10:20:01
	10:20:00	FM2	7	3MAG-SS#3	8/4/2005	9:29:01	10:20:01
		FM2	8	2OPS-SS#5	8/4/2005	9:29:01	10:20:01
		FM2	9	2OPS-SS#6	8/4/2005	9:29:01	10:20:01
		FM2	0	3MAG	8/4/2005	11:03:01	11:17:30
		FM2	1	2MAG	8/4/2005	11:03:01	11:17:30
		FM2	2	2OPS	8/4/2005	11:03:01	11:17:30
		FM2	3	2PAS	8/4/2005	11:03:01	11:17:30
		FM2	4	PVLS	8/4/2005	11:03:01	11:17:30
		FM2	5	3ES	8/4/2005	11:03:01	11:17:30
		FM2	6	3MAG-SS#2	8/4/2005	11:03:01	11:17:30
		FM2	7	3MAG-SS#3	8/4/2005	11:03:01	11:17:30
		FM2	8	2OPS-SS#5	8/4/2005	11:03:01	11:17:30
		FM2	9	2OPS-SS#6	8/4/2005	11:03:01	11:17:30
		FM2	0	3MAG	8/4/2005	12:31:00	12:48:00
		FM2	1	2MAG	8/4/2005	12:31:00	12:48:00
		FM2	2	2OPS	8/4/2005	12:31:00	12:48:00
		FM2	3	2PAS	8/4/2005	12:31:00	12:48:00
		FM2	4	PVLS	8/4/2005	12:31:00	12:48:00
		FM2	5	3ES	8/4/2005	12:31:00	12:48:00
		FM2	6	3MAG-SS#2	8/4/2005	12:31:00	12:48:00
		FM2	7	3MAG-SS#3	8/4/2005	12:31:00	12:48:00
		FM2	8	2OPS-SS#5	8/4/2005	12:31:00	12:48:00
		FM2	9	2OPS-SS#6	8/4/2005	12:31:00	12:48:00
		FM2	10	3MAG-BBPR	8/4/2005	12:31:00	12:48:00
		FM2	11	2MAG-BBPR	8/4/2005	12:31:00	12:48:00
		FM2	12	2OPS-BBPR	8/4/2005	12:31:00	12:48:00
		FM2	13	2PAS-BBPR	8/4/2005	12:31:00	12:48:00
		FM2	14	PVLS-BBPR	8/4/2005	12:31:00	12:48:00
		FM2	15	3ES-BBPR	8/4/2005	12:31:00	12:48:00
		FM2	0	3MAG	8/4/2005	13:25:00	13:39:00
		FM2	1	2MAG	8/4/2005	13:25:00	13:39:00
		FM2	2	2OPS	8/4/2005	13:25:00	13:39:00
		FM2	3	2PAS	8/4/2005	13:25:00	13:39:00
		FM2	4	PVLS	8/4/2005	13:25:00	13:39:00
		FM2	5	3ES	8/4/2005	13:25:00	13:39:00
		FM2	6	3MAG-SS#2	8/4/2005	13:25:00	13:39:00
		FM2	7	3MAG-SS#3	8/4/2005	13:25:00	13:39:00
		FM2	8	2OPS-SS#5	8/4/2005	13:25:00	13:39:00
		FM2	9	2OPS-SS#6	8/4/2005	13:25:00	13:39:00

		FM2	10	3MAG-BBPR	8/4/2005	13:25:00	13:39:00
		FM2	11	2MAG-BBPR	8/4/2005	13:25:00	13:39:00
		FM2	12	2OPS-BBPR	8/4/2005	13:25:00	13:39:00
		FM2	13	2PAS-BBPR	8/4/2005	13:25:00	13:39:00
		FM2	14	PVLS-BBPR	8/4/2005	13:25:00	13:39:00
		FM2	15	3ES-BBPR	8/4/2005	13:25:00	13:39:00
		FM2	0	3MAG	8/4/2005	14:17:00	14:31:08
		FM2	1	2MAG	8/4/2005	14:17:00	14:31:08
	14:39:08	FM2	2	2OPS	8/4/2005	14:17:00	14:31:08
		FM2	3	2PAS	8/4/2005	14:17:00	14:31:08
		FM2	4	PVLS	8/4/2005	14:17:00	14:31:08
		FM2	5	3ES	8/4/2005	14:17:00	14:31:08
		FM2	6	3MAG-SS#2	8/4/2005	14:17:00	14:31:08
		FM2	7	3MAG-SS#3	8/4/2005	14:17:00	14:31:08
	14:39:08	FM2	8	2OPS-SS#5	8/4/2005	14:17:00	14:31:08
	14:39:08	FM2	9	2OPS-SS#6	8/4/2005	14:17:00	14:31:08
		FM2	10	3MAG-BBPR	8/4/2005	14:17:00	14:31:08
		FM2	11	2MAG-BBPR	8/4/2005	14:17:00	14:31:08
	14:39:08	FM2	12	2OPS-BBPR	8/4/2005	14:17:00	14:31:08
		FM2	13	2PAS-BBPR	8/4/2005	14:17:00	14:31:08
		FM2	14	PVLS-BBPR	8/4/2005	14:17:00	14:31:08
		FM2	15	3ES-BBPR	8/4/2005	14:17:00	14:31:08

DF Nuisance	
Chan. 1	SBVS Weld
Chan. 2	ACST Grind

Compartment Summary						DF Algorithm	
FM	FM	FM	FM	FM	FM	Nuisance	Nuisance
Flame	*Smoke*	*Water*	*Thermal*	*Gas Release*	*Suppression*	*Chan.1*	*Chan.2*
Flame	**Smoke**	**Water**	**Thermal**	**Gas Release**	**Suppression**	**Nuisance**	**Nuisance**
11:19:09	11:21:34	DNA	DNA	DNA	DNA	DNA	DNA
11:21:04	11:19:27	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	11:19:29	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
11:19:09	11:21:34	DNA	DNA	DNA	DNA	DNA	DNA
11:21:05	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	11:19:37	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	13:58:53	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	13:54:22	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	13:54:25	DNA
DNA	DNA	DNA	DNA	DNA	DNA	13:54:22	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	14:36:31	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	14:43:18	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	14:43:18	DNA	DNA
9:36:11	9:35:14	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA

9:31:01	9:30:51	9:35:08	DNA	DNA	9:36:10	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
9:36:11	9:35:14	DNA	DNA	DNA	DNA	DNA	DNA
9:36:39	9:35:22	DNA	DNA	DNA	DNA	DNA	DNA
9:31:01	9:30:51	DNA	DNA	DNA	9:36:10	DNA	DNA
9:31:17	9:32:37	9:35:08	DNA	DNA	DNA	DNA	DNA
DNA	DNA	10:42:01	DNA	DNA	DNA	DNA	DNA
DNA	10:47:42	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	10:48:46	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	10:42:01	DNA	DNA	DNA	DNA	DNA
DNA	DNA	10:42:01	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	10:48:46	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	12:18:39	12:22:48	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	12:18:39	DNA	DNA	DNA	DNA	DNA	DNA
DNA	12:22:59	12:22:48	DNA	DNA	DNA	DNA	DNA
DNA	DNA	13:30:56	DNA	DNA	DNA	DNA	13:32:04
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	13:31:43	DNA	DNA
13:23:39	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	13:31:42	DNA	DNA
DNA	DNA	13:30:55	DNA	DNA	DNA	DNA	13:32:02
DNA	DNA	13:30:56	DNA	DNA	DNA	DNA	13:32:29
DNA	DNA	13:31:02	DNA	DNA	DNA	DNA	13:32:04
DNA	DNA	DNA	DNA	DNA	13:31:43	DNA	DNA
DNA	DNA	DNA	DNA	DNA	13:31:45	DNA	DNA
14:25:00	14:27:55	DNA	DNA	DNA	DNA	DNA	DNA

DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
14:23:33	14:28:48	DNA	DNA	DNA	DNA	DNA	DNA
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
14:25:00	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	14:27:55	DNA	DNA	DNA	DNA	DNA	DNA
14:28:36	14:28:48	DNA	DNA	DNA	DNA	DNA	DNA
14:23:33	DNA	DNA	DNA	DNA	DNA	DNA	DNA
10:26:18	DNA	DNA	DNA	DNA	DNA	DNA	DNA
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10:27:10	DNA	DNA	DNA	DNA	DNA	DNA	DNA
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DNA	12:35:45	DNA	DNA	DNA	DNA	DNA	DNA
13:57:08	13:57:57	DNA	DNA	DNA	DNA	DNA	DNA
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DNA	13:57:57	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	13:56:10	DNA	DNA
DNA	DNA	DNA	DNA	DNA	13:56:10	DNA	DNA

DNA	DNA	DNA	DNA	DNA	DNA	DNA	14:32:38
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DNA	14:42:50	DNA	DNA	DNA	DNA	DNA	14:35:16
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DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	14:35:18
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DNA	14:42:50	DNA	DNA	DNA	DNA	DNA	14:35:16
DNA	14:43:20	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	8:54:16	DNA	DNA	DNA	DNA	DNA	DNA
9:00:49	8:58:35	DNA	DNA	DNA	DNA	8:50:51	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
9:00:58	8:54:56	DNA	DNA	DNA	DNA	DNA	DNA
9:00:49	9:01:16	DNA	DNA	DNA	DNA	8:50:51	DNA
DNA	9:51:36	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	9:36:46	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
DNA	9:36:07	DNA	DNA	DNA	DNA	DNA	DNA
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DNA	9:51:36	DNA	DNA	DNA	DNA	DNA	DNA
DNA	DNA	DNA	DNA	DNA	9:36:52	DNA	DNA
DNA	DNA	DNA	DNA	DNA	9:36:46	DNA	DNA
DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
10:52:56	10:52:25	DNA	DNA	DNA	DNA	DNA	10:49:39
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DF Flame (same suite)	
Chan. 1	SBVS Fire FOV
Chan. 2	SBVS Fire + LWVD
Chan. 3	SBVS Fire + CVID Flame
Chan. 4	SBVS Fire + CVID Reflected

*DF Flame (cross suite)**	
Chan. 1	SBVS Fire + LWVD
Chan. 2	SBVS Fire + CVID Flame
Chan. 3	SBVS Fire + CVID Reflected

** Cross suite only logged when same suite absent.*

DF Algorithm	***DF Algorithm***				***DF Algorithm***		
Bright Nuis.	**Flame**	**Flame**	**Flame**	**Flame**	**XFlame**	**XFlame**	**XFlame**
Chan.1	*Chan.1*	*Chan.2*	*Chan.3*	*Chan.4*	*Chan.1*	*Chan.2*	*Chan.3*
Nuisance	**Flame**	**Flame**	**Flame**	**Flame**	**Flame**	**Flame**	**Flame**
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DF Smoke	
Chan. 1	SBVS Smoke
Chan. 2	CVID Smoke

DF Algorithm		DF Algorithm	DF Algorithm	DF Algorithm		
Smoke	Smoke	Water	Gas Release	Suppression		
Chan.1	Chan.2	Chan.1	Chan.1	Chan.1Cl	ass 1	Class 2
Smoke	Smoke	Water	Gas Release	Suppression	Fire	Bright Nuisance
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DF Algorithm						
Bayesian Belief Pattern Recognition (BBPR) Results						
Class 3	*Class 4*	*Class 5*	*Class 6*	*Class 7*	*Class 8*	*Class 9*
Water	**Gas Release**	**Suppression**	**Engine**	**Grinding**	**Background**	**People**

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